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Ten New Species of *Erythroxylum* (Erythroxylaceae) from Bahia, Brazil

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Abstract

Ten new species of *Erythroxylum* (Erythroxylaceae) from the state of Bahia and adjacent areas in Brazil are described and illustrated, and their taxonomic and ecogeographic relationships are discussed: **E. andrei** Plowman, **E. caatingae** Plowman, **E. maracasense** Plowman, **E. mattos-silvae** Plowman, **E. membranaceum** Plowman, **E. petraecaballi** Plowman, **E. santosii** Plowman, **E. splendidum** Plowman, **E. stipulosum** Plowman, and **E. tenue** Plowman.

Introduction

Since I began studies of Neotropical *Erythroxylum* in 1974, no one region has presented such diversity of taxa and such a challenge in their delimitation as the state of Bahia, Brazil. I have now tallied 45 species from this state alone. In the Neotropics, Bahia is rivaled only by Venezuela in numbers of species of *Erythroxylum* in a comparable area (Plowman, 1982). The interesting juxtaposition of habitats from restinga and moist tropical forest along the coast to dry caatinga, campo rupestre and cerrado in the interior has led to a radiation of species that we are only beginning to describe, let alone understand.

Within Bahia, the greatest concentration of species of *Erythroxylum* occurs along the coast in restinga and restinga forests on sandy soils. Other species occur in both restinga forest and moist tropical forest; for still others we do not yet know the habitat within the coastal zone.

From studying recent collections from southern Bahia and from my own fieldwork there, it has become clear that many species of *Erythroxylum* occur naturally in very small populations and are restricted to limited areas. One example is *Erythroxylum hamigerum* O. E. Schulz collected in 1821 by Riedel at "Castelnovo" (= Castelo Novo) near Ilhéus and in 1836 by Blanchet also near Ilhéus. In spite of intensive collecting around Ilhéus in the last 15 years, this species has been found only once: in 1983 at Lagoa Encantada near Castelo Novo, where Riedel first discovered it. Another example is *E. mattos-silvae* Plowman, described here, which is found locally in restinga forests south of Ilhéus but was not collected until 1969. Other species, such as *E. nitidum* Sprengel, *E. membranaceum* Plowman, or *E. santosii* Plowman, are known only from single collections. The continuing decimation of the forests of southern Bahia for agriculture and housing developments has greatly increased the probability that many of the very rare and local erythroxylums, along with hundreds of other species not protected in forest preserves, will become extinct in the near future.

Our knowledge of the southern Bahian flora is owed largely to the Centro de Pesquisas do Cacau (CEPEC), a division of the Commissão Executiva do Plano da Lavoura Cacaueira (CEPLAC). The staff of this institution has been actively collecting this area for the past 15 years, resulting in a significant increase in the numbers of new species and species records for Bahia (Mori & Mattos Silva, 1979; Mattos Silva & Mori, 1981).

It is becoming increasingly clear that caatinga and other dry habitats of northeastern Brazil are also rich in species of *Erythroxylum*; but the vast, dry areas of the interior are very poorly explored compared with the areas of the narrow coastal belt.

Recent explorations of caatinga areas have been carried out by Ray Harley and colleagues from the Royal Botanic Gardens, Kew, by Scott Mori of the New York Botanical Garden, and by the staff at the Herbario Radambrasil in Salvador. Other recent collectors in Bahia have also made important contributions, especially the botanists at the Universidade Federal da Bahia in Salvador and at the Universidade Estadual de Feira de Santana (Britto & Noblick, 1984). These collections suggest that, when better collected, the dry habitats of Bahia and other areas of the Northeast may be nearly as rich in *Erythroxylum* species, including endemics, as the moist forests.

It is the purpose of this paper to describe 10 new species of *Erythroxylum,* six from restinga and restinga forest, and four from caatinga and dry forest. This is the second contribution (see Plowman, 1983) toward a revision of the species of *Erythroxylum* in Bahia. Because of the long-recognized difficulty in distinguishing *Erythroxylum* species, I have provided rather long and detailed descriptions, employing as many useful characters as possible in order to avoid any future ambiguity in interpreting these concepts.

Since my last contributions to the taxonomy of this genus (Plowman, 1983, 1984), I have made some modifications in terminology. Following Schulz (1907) and earlier workers, I formerly used "ramenta" to designate the stem covering of congested, sometimes modified cataphylls (consisting of stipules without developed leaf blades). Since there appear to be many intermediate conditions between densely congested "ramenta" and scattered and isolated cataphylls, I believe it is better to abandon the rather vague term "ramenta" and replace it with a simple description of the nature of the cataphylls. In earlier descriptions, I did not consider the minute, spinelike leaf rudiment usually found on cataphylls, but I now include this character, which I have designated the "spinule."

New Species Descriptions

1. **Erythroxylum andrei** Plowman, sp. nov. sect. **Rhabdophyllum.** Figures 1–2, 10.

Frutex ramosissimus, ramulis flexuosis. Cataphylla disticha, stipulis foliorum similia. Stipulae foliares persistentes, parvae, transverse triangulares, coriaceae, striate nervosae, 3-setulosae. Folia breviter petiolata, persistentia; laminae obovatae vel ovatae vel suborbiculares, apice obtusae vel rotundatae, retusae, basi obtusae vel rotundatae vel late cuneatae, chartaceae vel subcoriaceae. Flores e brachyblastis vel ramulis hornotinis in ramentorum axillis nati, brevissime pedunculati. Petali lamina elliptica, ungue amplo et ligula bilobata munita. Urceolus stamineus calycem superans, margine integer vel minute 10-crenulatus. Styli liberi. Drupa ignota.

Shrub to 6 m tall, densely branched, with several trunks to 3 cm diameter. **Bark** rather smooth, dotted with small rounded or elongate lenticels or longitudinally striate, grayish brown, ca. 2 mm thick, the inner bark tan, the wood light tan, very hard. **Branches** dense, ascending or upcurving, not distinctly storied. **Branchlets** distichous, consisting mainly of short shoots, flexuous, diverging 50°–90° from axis, strongly compressed at apex, 1.5–2 mm in diameter, dotted with rounded or elongate, pale tan lenticels. **Internodes** 3–20 mm long on long shoots, 0.5–1 mm long on short shoots. **Cataphylls** (ramenta) distichous, produced at base of new shoots for up to 8 mm, scarcely overlapping, similar to foliar stipules, persisting, turning black with age, the spinule (leaf rudiment) slender, black, ca. 1 mm long. **Foliar stipules** persistent, appressed to stem, diverging somewhat with age, broadly triangular, 1.5–2 mm long, coriaceous, striate-nerved with 5–6 parallel nerves per side, obtuse to rounded at apex, 3-setulose, the 2 lateral setae 0.4–0.5 mm long, the medial seta variable in length, 0.2–0.7 mm long, the setae evanescent with age, the keels prominent, riblike, the margin entire. **Leaves** persistent, 1–2 produced at tips of short shoots or scattered on long shoots, distichous, short-petiolate, the lamina held obliquely erect, plane, variable in shape, ovate to obovate or suborbicular, obtuse to rounded at apex, retuse, obtuse to rounded or broadly cuneate at base, 35–85 mm long, 20–55 mm wide, firmly chartaceous to subcoriaceous, adaxially medium to dark green, drying dull, grayish green, abaxially light yellowish green, drying yellowish or reddish brown, adaxially rather dull to shiny, abaxially shiny, elineate with no distinct central panel, the adaxial midrib yellowish or light green, flat or only slightly raised, the major lateral nerves 10–14, diverging 55°–70° from midrib, straight, more or less parallel, anastomosing 2–4 mm from margin, adaxially obscure, abaxially distinct. **Petiole** subterete, 2–3 mm long, 1–1.3 mm in diameter, drying very dark brown. **Flowers** produced near the apex of new short shoots or new long shoots in axils of leaves or cataphylls, 1–4 per node, whitish, subsessile or very short-pedunculate, the peduncle flattened against stem, 0.2–1.2 mm long, diverging from axis with age.

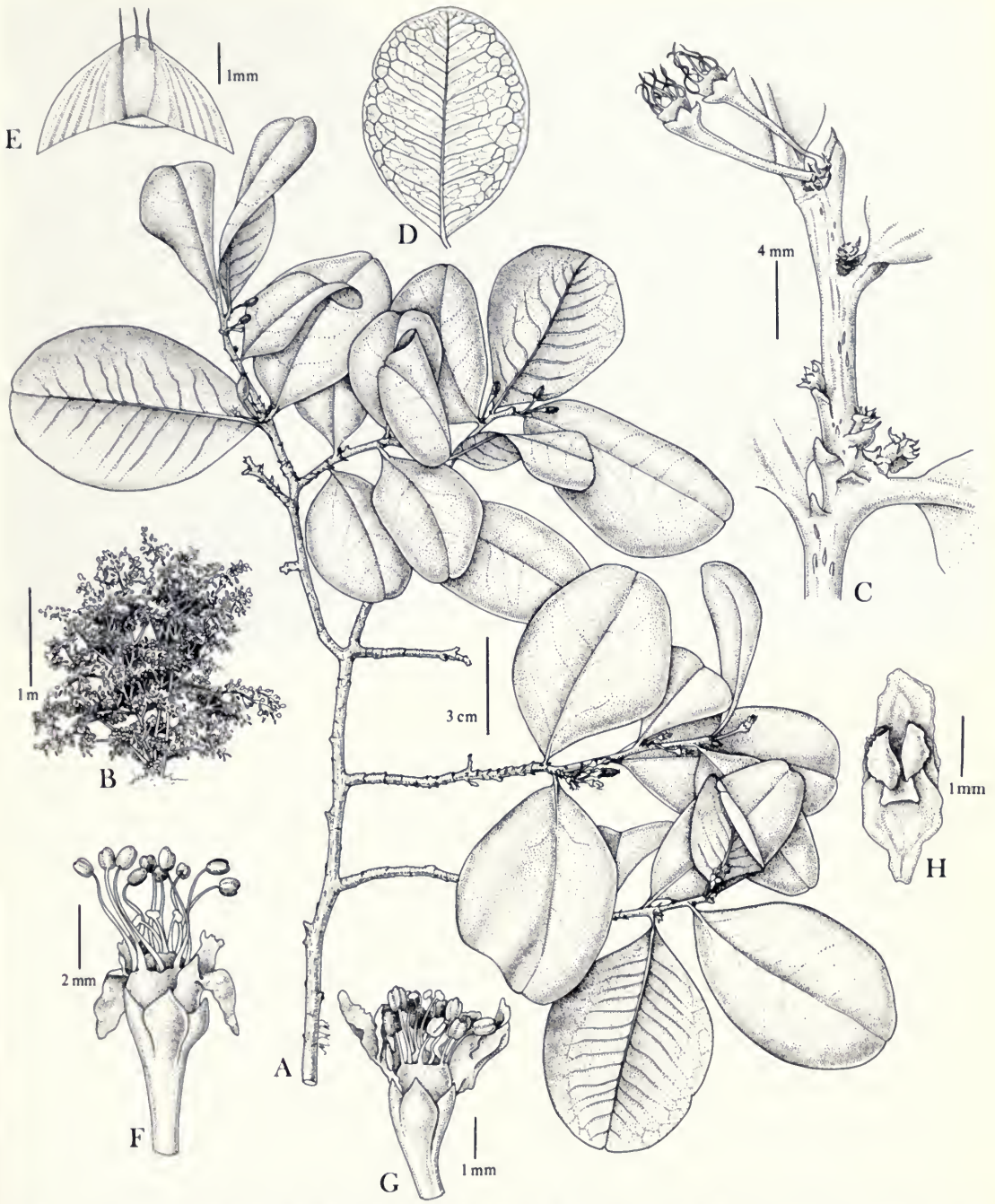

FIG. 1. *Erythroxylum andrei*. **A,** habit of flowering branch; **B,** habit of whole plant; **C,** detail of flowering twig; **D,** leaf showing venation, scale as in A; **E,** stipule; **F,** short-styled flower; **G,** long-styled flower; **H,** petal. (A, C, D, E, F, and H from *Carvalho et al. 198*; B from *Plowman & Carvalho 12785*; G from *dos Santos 1287*.) Drawing by Marlene Werner.

FIG. 2. Habitat of *Erythroxylum andrei* in shrubby restinga near Maraú, Bahia, Brazil (*Plowman & Carvalho 12785*).

Bracteoles minute, produced at apex of peduncle, broadly ovate, concave, membranaceous, 0.6–0.8 mm long, abruptly acuminate at apex, the seta 0.2–0.4 mm long. **Pedicel** slender, 5-ribbed, 3.5–6.5 mm long, 0.5–0.7 mm in diameter, thickened at apex into the calyx. **Calyx** 1.2–1.5 mm long, divided ⅓–½ its length, the lobes broadly triangular, 0.5–0.7 mm long, apically acute. **Petal** lamina spreading, concave, elliptic to narrowly ovate, rounded at apex, 2 mm long, 1–1.5 mm wide, the claw broad and somewhat larger than the lamina, 1.5–1.6 mm long, to 1.7 mm wide, the ligule 1.4 mm long, bilobate, with a broad, inflexed, central flap 0.7–0.8 mm long and 0.6 mm wide, the lobes each consisting of 2 auricles, the shorter anterior auricle 0.6 mm long, the longer posterior auricle 1–1.4 mm long. **Staminal cup** 1.2–1.8 times length of calyx, 1–1.3 mm long, entire to minutely 10-crenulate at margin, the margin itself drying thin, lighter brown in color, flaring slightly. **Brachystylous flowers:** filaments 2.5–2.8 mm long, the anthers 0.5 mm long; styles free, 1 mm long; stigma broadly depressed-capitate, 0.2 mm long, 0.3 mm in diameter. **Dolichostylous flowers:** antisepalous filaments 0.8 mm long, the anthers 0.5 mm long; antipetalous filaments 1.2 mm long, the anthers 0.5 mm long; styles free, 1–1.1 mm long; stigmas depressed-capitate, 0.2 mm long. **Ovary** obovoid, rounded at apex, 1.2–1.8 times length of staminal cup, 0.8–1.8 mm long. Mature **drupe** unknown.

TYPE—Brazil, Bahia, Município de Maraú, rodovia BR-030, trecho Porto de Campinhos-Maraú, km 11, restinga, arbusto de ap. 2.0 m de altura, folhas discolores com face superior lúcida, flores alvacentas, frutos imaturos verdes, 26 Feb. 1980 (fl), *André M. de Carvalho, L. A. Mattos Silva & T. S. dos Santos 198* (holotype, CEPEC 19131; isotypes, F 1884879, F neg. 60193, K, NY, RB).

ADDITIONAL SPECIMENS EXAMINED—**BRAZIL: Alagoas:** Município Marechal Deodoro: Massagueira, entrada para Barra de São Miguel, 30 Jan. 1982 (fl), *M. L. Guedes s.n.* (ALCB, F). **Bahia:** Município de Maraú: Estrada Ubaitaba–Ponta do Mutá, ramal no km 71 de Ubaitaba, entrada para o Sitio "São Marcos," approx. 14°04′S, 38°58′W, near sea level, 2 Feb. 1983 (fl buds), *T. Plowman & A. M. de Carvalho 12785* (ALCB, B, CEPEC, F, G, GH, GUA, HRB, K, LE, MBM, MO, NY, P, R, RB, SP, U, UB, UEC, US, distributed as "*E. carvalhoi*"), 2 Feb. 1983 (st), *T. Plowman & A. M. de Carvalho 12786* (CEPEC, F, GH, HRB, K, NY, RB, UB, US, distributed as "*E. carvalhoi*"). Município de Ilhéus: estrada a Olivença, 12 Nov. 1970

(fl), *T. S. dos Santos 1287* (CEPEC, F); Fazenda Barra do Manguinho, km 12 da Rodovia (BA-001) Pontal–Olivença, 26 Apr. 1983) (fl, fr), *L. A. Mattos Silva, T. S. dos Santos & B. Leuenberger 1823* (ALCB, CEPEC, F, MBM, NY, RB), 27 Feb. 1985 (st), *T. Plowman, L. A. Mattos Silva & T. S. dos Santos 13971* (CEPEC, F, K, NY, RB), 27 Feb. 1985 (young fr), *T. Plowman, L. A. Mattos Silva & T. S. dos Santos 13973* (CEPEC, F, G, HRB, IPA, K, NY, RB, UEC, US); Fazenda Guanabara, ramal com entrada no km 10 da rodovia Ilhéus–Olivença, lado direito 4 km a Oeste da rodovia, 7 Mar. 1985 (fr), *L. A. Mattos Silva, T. S. dos Santos & H. S. Brito 1363* (CEPEC, F). Município de Pôrto Seguro: estrada de Arraial d'Ajuda para Trancoso, 20 Apr. 1982 (fl, young fr), *A. M. de Carvalho, S. G. da Vinha & H. S. Brito 1249* (CEPEC, F, HRB, RB).

ETYMOLOGY—*Erythroxylum andrei* commemorates André M. de Carvalho, botanist and former curator at the CEPEC herbarium. He has made excellent recent collections of the southern Bahian flora and first brought this species to my attention. I originally intended to name this species "*E. carvalhoi,*" and some of my collections were distributed under this name. I subsequently discovered that this epithet is preoccupied by *E. carvalhoi* (Engl.) Phillips, a new combination proposed in 1935 for *Nectaropetalum carvalhoi* Engl. from Mozambique (Phillips, 1935).

DISTRIBUTION—Known only from the coast of eastern Brazil from the states of Alagoas and Bahia.

ECOLOGY—*Erythroxylum andrei* grows only in open, low restinga formations near the sea. It may be locally common, but is known from only four localities. In the area south of Ilhéus, Bahia, its habitat is seriously threatened by vacation housing developments and sand mining.

PHENOLOGY—Flowering specimens have been collected in November, January, February, and April. Mature fruits are unknown.

RELATIONSHIPS—Based on its having striately nerved stipules and relatively small calyx lobes, *Erythroxylum andrei* is placed in the large Neotropical section *Rhabdophyllum* O. E. Schulz. It superficially resembles several other species from Bahia that also occur in restinga formations. It differs from *E. leal-costae* Plowman in having more slender twigs (1–2 mm vs. 3–4 mm), the leaves abaxially shiny, the venation more prominent, the flowers short-pedunculate, and the pedicels longer (4–6.5 mm vs. 1.5–2 mm). *Erythroxylum andrei* differs from *E. passerinum* Mart. in having a flat adaxial midrib without a distinct, slender ridge, well-developed short shoots, shorter (1.2–2 mm vs. 2–3.5 mm) and broader stipules with more pronounced nerves, thicker leaves with more prominent and more open venation, and the staminal cup exceeding, rather than shorter than, the calyx.

2. **Erythroxylum caatingae** Plowman, sp. nov. sect. **Archerythroxylum.** Figures 3, 10.

Arbor parva vel frutex ramosissimus, ramulis rectis, crassis, nigrescentibus. Cataphylla pauca, stipulis foliaribus similia. Stipulae foliares mediocres, triangulari-ovatae, estriatae, apice integrae vel brevissime 2-setulosae, fugaces. Folia petiolata, decidua; laminae ellipticae vel oblongae, raro suborbiculares vel obovatae, apice rotundatae, retusae, basi obtusae vel rotundatae vel late cuneatae, firme chartaceae vel subcoriaceae. Flores 1–5, e brachyblastis hornotinis in ramentorum vel foliorum axillis nati, pedicellis brevibus, incrassatis, 5-costatis. Petali lamina ovata, ligula bilobata munita. Urceolus stamineus calycem aequans, margine 10-crenatus. Styli ad basin tantum connati. Drupa endocarpio triquetro, triloculari, duabus loculis sterilibus magnis, loculo fertili parvo provisa.

Shrub or small tree, 1.5–4 m tall, much-branched and with a broad crown. **Branches** distichous, often at near right angles to axis, rigid, thick, becoming smooth and black. **Branchlets** distichous, consisting of both long and short shoots, diverging 50°–90° from axis, compressed at apex, 1.5–2 mm in diameter, stiff, longitudinally wrinkled, dark brown to black, the lenticels numerous, punctate to elongate, whitish, the bark becoming longitudinally striate. **Internodes** 2–13 mm long on long shoots, 1–3 mm long on short shoots. **Cataphylls** (ramenta) sparse, up to 5 scattered along base of long shoots or alternating with leaves on short shoots, similar in form to foliar stipules, the spinule (leaf rudiment) 2–2.5 mm long, dark brown to black, very early caducous. **Foliar stipules** distichous, persisting for 1 or 2 seasons, then marcescent, appressed to stem, slightly diverging with age, triangular-ovate, 2.5–4 mm long, firmly membranaceous, smooth, nonstriate, when mature drying reddish brown, obtuse at apex, entire or briefly 2-setulose, the setae short-filamentous, 0.2–0.8 mm long, evanescent, the keels sub-alate, the margin entire. **Leaves** deciduous, scattered on long shoots or 1–5 produced near apex of short shoots, distichous, petiolate, the lamina plane or somewhat undulate, elliptic to oblong, rarely suborbicular or obovate, rounded or retuse at apex, obtuse to rounded or broadly cuneate at base, 15–52 mm long, 10–35 mm wide, firmly chartaceous to subcoriaceous, adaxially medium green, drying olive green to dark brown, abaxially pale green, drying pale olive green to pale brown, adaxially dull to somewhat shiny, abaxially matte, elineate with no distinct central panel, the adaxial midrib flat or

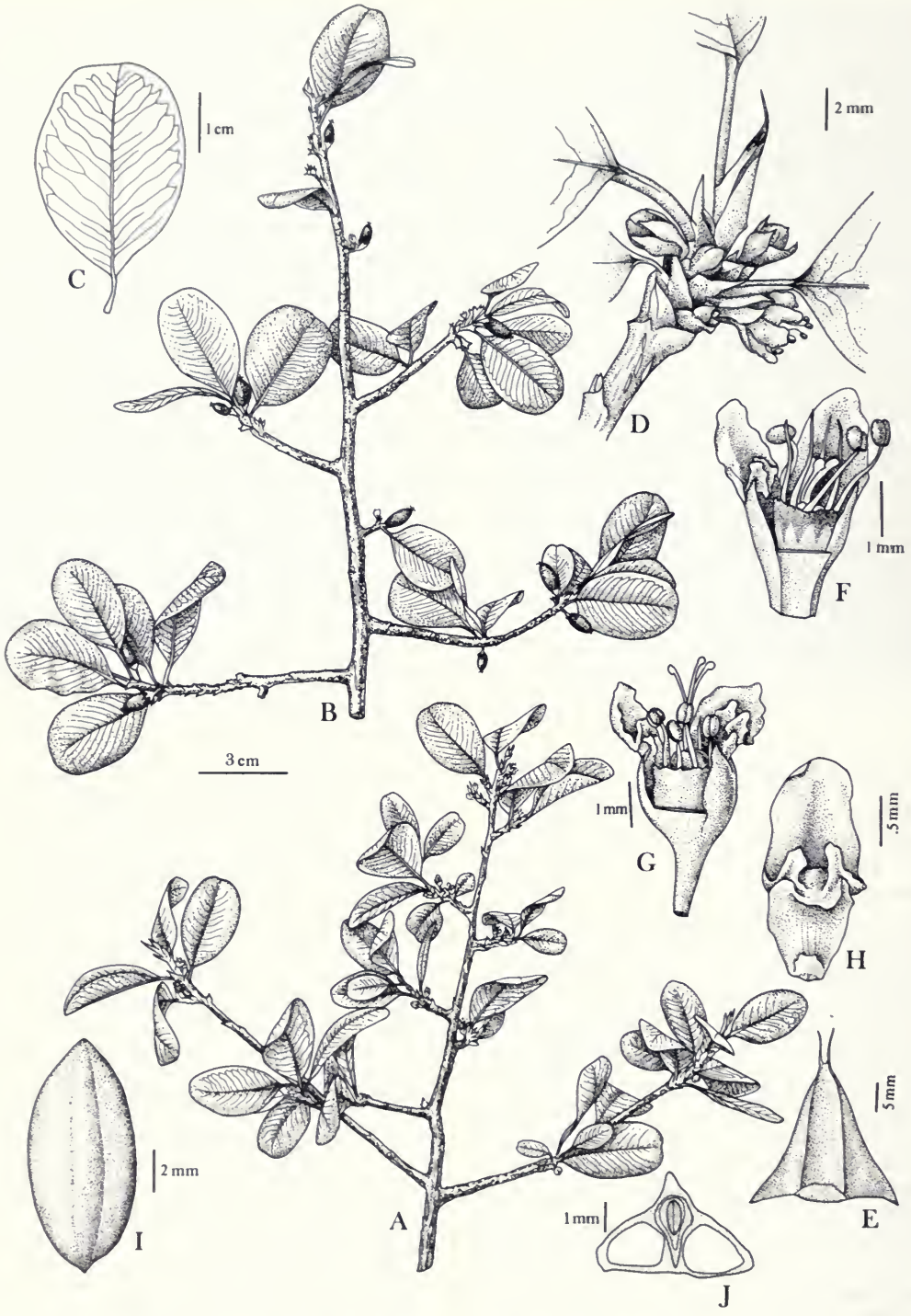

FIG. 3. *Erythroxylum caatingae*. **A,** flowering branch, 3-cm scale; **B,** fruiting branch, 3-cm scale; **C,** leaf showing venation; **D,** detail of apex of flowering twig; **E,** stipule; **F,** short-styled flower; **G,** long-styled flower; **H,** petal; **I,** dorsal view of endocarp; **J,** cross section of endocarp. (A, D, E, F, and H from *Harley et al. 16473*; B and C from *Mori 13443*; G from *Leal Costa s.n.*; I and J from *Harley et al. 16928*.) Drawing by Marlene Werner.

somewhat furrowed, the abaxial midrib drying light straw-colored, the lateral nerves 12–14, diverging 30°–50° from midrib, sinuous, more or less parallel, anastomosing 0.5–2 mm from midrib, prominulous on both surfaces. **Petiole** 3–6 mm long, 0.5–0.8 mm in diameter, subterete, narrowly canaliculate. **Flowers** in axils of leaves or cataphylls on current season's shoots, 1–3 (5) per node, sparse to somewhat congested, white, greenish white, or yellowish. **Bracteoles** broadly ovate to orbicular, concave, 1–1.5 mm long, paleaceous, acute to acuminate at apex, the seta 0.3–0.5 mm long. **Pedicel** pentagonal, 5-ribbed, somewhat thickened, 1–1.5 mm long, 0.5–1 mm in diameter. **Calyx** 1.5–2.5 mm long, divided ½–⅔ its length, pale green, the lobes ovate to ovate-lanceolate, 1–1.5 mm long. **Petal** lamina ovate, 1.7–2.5 mm long, 1.3–1.5 mm wide, rounded or obtuse at apex, concave, often incurved, the claw 1.2–1.5 mm long, the ligule bilobed, 0.7–1 mm long, each lobe consisting of a posterior ovate auricle 0.5–0.7 mm long, sometimes with a very short, cufflike, anterior auricle and with a broad, inflexed, medial flap between the lobes. **Staminal cup** ¾ the length of calyx, 1.2–1.5 mm long, the margin 10-crenate. **Brachystylous flowers:** filaments 1.8–2 mm long, the anthers ovate-elliptic, 0.6 mm long; styles 1 mm long, briefly connate at base; stigmas depressed-capitate, 0.3 mm long. **Dolichostylous flowers:** antisepalous filaments 0.6–0.7 mm long, the anthers elliptic, 0.6 mm long; antipetalous filaments 1.1–1.2 mm long, the anthers elliptic, 0.5 mm long; styles 2–2.5 mm long, connate at base 0.5–0.8 mm; stigmas depressed-capitate, 0.2–0.3 mm long. **Ovary** equaling the staminal cup, obovoid, rounded at apex, 1.4–1.5 mm long. **Drupe** ellipsoid, rounded at apex, 8–10 mm long, 4.2–5.2 mm in diameter, reddish orange to scarlet at maturity, the mesocarp thin, the endocarp oblong to ellipsoid in outline, trigonal in cross section with 1 wider flat side and 2 narrower, shallowly indented sides, 3-locular with 2 large, empty locules and 1 small, fertile locule; endosperm occupying ca 10%–20% of fertile locule. **Embryo** 5.5–6.7 mm long, pale green; cotyledons very thin, oblong, rounded at apex, 4.2–5 mm long, 1.5–1.7 mm wide, 0.1 mm thick; radicle 1.6–1.7 mm long, 0.5 mm in diameter.

TYPE—Brazil, Bahia, Raso da Catarina, vegetação caatinga, arbusto de mais ou menos 2,5 m de altura, flores pequenas, amarelo-claro, frutos imaturos e maturos (cor-de-abóbora), 14 May 1981 (fl, fr), *H. P. Bautista 445* (holotype, HRB 2356; isotypes, CEPEC 26479, F 1912521).

ADDITIONAL SPECIMENS EXAMINED—**BRAZIL: Ceará:** 2–4 km south of Campos Sales, alt. 620 m, 7°14′S, 40°25′W, 15 Feb. 1985 (fl), *A. Gentry, E. Zardini & A. Fernandes 50140* (EAC, F, MO). **Paraíba:** Borborema, "imbuzeiro bravo," Nov. 1936 (fl, fr), *H. Zenaide 27* (SP). **Pernambuco:** entre Bom Nome e São José do Belmonte, 13 May 1971 (fr), *Academia Brasileira de Ciências (E. P. Heringer, D. de A. Lima, J. de P. L. Sobrinho & A. C. Sarmento) 730* (F, IPA, RB, UB); entre Airí e Serra Negra, 8 Feb. 1949 (st), *D. de A. Lima 49-178* (IPA); Santa Maria da Boa Vista, margem da PE-4, em direção a Jutaí, 29 Apr. 1971 (fl), *Academia Brasileira de Ciências (E. P. Heringer, D. de A. Lima, J. de P. L. Sobrinho & A. C. Sarmento) 376* (F, IPA, RB, UB); Afrânio, Caboclo, Serra do Caboclo, 21 Apr. 1971 (fl, fr), *Academia Brasileira de Ciências (E. P. Heringer, D. de A. Lima, J. de P. L. Sobrinho & A. C. Sarmento) 260* (F, IPA, RB, UB). **Bahia:** Estação Ecológico do Raso da Catarina, 26 Jun. 1982 (fl), *L. Paganucci de Queiroz 380* (ALCB, F); no entroncamento da estrada de Jorro com a de Tucano, 4 Feb. 1983 (fl), *A. Leal Costa s.n.* (ALCB, F). Município Nossa Senhora dos Milagres: estrada para Itaberaba, km 10, estradinha para as fazendas Morros e Antonio Romeu, km 2, 28 Jan. 1973 (fr), *I. & G. Gottsberger 27-28173* (F); Iaçú, Fazenda Suibra, 18 km a leste da cidade sequindo a ferrovia, 12 Mar. 1985 (fr), *L. Noblick & Lemos 3581* (F, HUEFS); 14 km SW of Cansanção on road to Queimadas, ca. 30°34′W, 10°47′S, alt. ca. 300 m, 22 Feb. 1974 (fl), *R. M. Harley et al. 16473* (CEPEC, IPA, K, MO, NY, P, RB, U, US); Serra do Curral Feio, 26 km NW of Lagoinha (which is 5.5 km SW of Delfino) on side road to Minas do Mimoso, ca. 41°23′W, 10°16′S, 7 Mar. 1974 (fr), *R. M. Harley et al. 16928* (CEPEC, GH, K, MO, NY, P, RB, U, US); Serra Açuruá, ca. 4 km NE from Gentio do Ouro along road toward Central, ca. 42°30′W, 11°24′S, alt. ca. 1000 m, 22 Feb. 1977 (fr), *R. M. Harley et al. 18958* (CEPEC, F, K, NY, P, RB, U). Região da Serra do Sincorá, "Iracema" [= Iramaia], 18 Feb. 1943 (fl, young fr), *R. de L. Fróes 20183* (IAN, NY, US); km 43 da estrada Brumado–Caetité, alt. 740 m, 14 Apr. 1983 (fl, fr), *A. M. de Carvalho, B. Leuenberger & L. A. Mattos Silva 1694* (ALCB, B, CEPEC, F, RB).

ETYMOLOGY—The specific epithet *caatingae* means "of the caatinga," in reference to the exclusively northeastern Brazilian habitat of this species.

DISTRIBUTION—*Erythroxylum caatingae* is known only from northeastern Brazil from the state of Paraíba south to Bahia.

ECOLOGY—Most collections of *E. caatingae* mention the habitat as "caatinga," the type of dry vegetation characteristic of northeastern Brazil. Only one collection (*Harley et al. 18958*) provides more detailed habitat information: "caatinga on sand and with quartzitic rocks and metamorphosed sandstones forming rock area with more open vegetation including extensive areas of *Vellozia*."

PHENOLOGY—In Pernambuco and Bahia, *Erythroxylum caatingae* appears to flower and fruit

TABLE 1. Morphological comparison of *Erythroxylum caatingae* Plowman and *E. oxypetalum* O. E. Schulz.

Character	*E. caatingae*	*E. oxypetalum*
Branchlets	Thick, rigid	Slender, flexuous
Leaf texture	Firmly chartaceous, subcoriaceous	Membranaceous
Leaf base	Rounded, obtuse	Acuminate, acute
Pedicel length (mm)	1–1.5	2–2.5
Pedicel diameter (mm)	0.5–1	0.2–0.4
Calyx lobe shape	Ovate to lanceolate	Triangular
Calyx lobe length (mm)	1–1.5	0.7

during the rainy season, primarily from February to April. The sole collection from Paraíba was collected in flower and fruit in November.

COMMON NAME—"Imbuzeiro bravo" (Paraíba).

RELATIONSHIPS—*Erythroxylum caatingae* looks superficially like a number of other stiff-branched caatinga species, such as *E. pungens* O. E. Schulz, *E. nummularia* Peyr., and *E. bezerrae* Plowman, a new species from Piauí (Plowman, 1986). It is readily distinguished from *E. pungens* and *E. bezerrae* in having nonstriate stipules and from *E. nummularia* in having petiolate leaves.

Erythroxylum caatingae belongs to section *Archerythroxylum* based on its nonstriate stipules and perfect flowers. It is most closely related to *E. oxypetalum* O. E. Schulz, a rare species known only from two collections from central (Diamantina, *Glaziou 12473*, holotype, B, destroyed, F neg. 12634; isotypes, C, G, K, LE, P, R) and northeastern Minas Gerais (estrada Itaobim–Joaíma, *Mendes Magalhães 17628*, IAN). Morphological differences between these two species are listed in Table 1. Although *E. oxypetalum* appears also to grow in caatinga vegetation, it has a more southerly distribution, and the two species are allopatric.

3. **Erythroxylum maracasense** Plowman, sp. nov. sect. **Rhabdophyllum** O. E. Schulz. Figures 4–5, 10.

Frutex vel arbuscula, ramulis rectis vel subflexuosis, lenticellis instructis. Cataphylla pauca, brevia, disticha, stipulis foliaribus similia. Stipulae foliares persistentes, parvae, triangulari-ovatae, striate nervosae, breviter 3-setulosae. Folia parva, subsessilia vel brevissime petiolata, decidua; laminae late obovatae, ellipticae vel orbiculares, apice rotundatae vel retusae, basi late cuneatae vel obtusae, membranaceae. Flores e brachyblastis in axillis cataphyllorum hornotinorum nati. Petali lamina ovata vel elliptica, ungue lato et ligula bilobata munita. Urceolus stamineus quartae vel duabus tertiis partibus longitudinis calycis aequalis, margine 10-crenulatus vel 10-denticulatus. Styli liberi. Drupa endocarpio oblongo-ovoideo, manifeste 6-sulcato provisa.

Shrub or treelet to 4 m tall. **Bark** rather smooth, thin, light brown, dark brown within, the wood very light tan. **Branches** more or less distichous, ascending and spreading, straight or somewhat flexuous, dark brown. **Branchlets** distichous, more or less straight, often parallel, weakly differentiated into long and short shoots, diverging 30°–65° from axis, somewhat compressed toward apex, 1–1.5 mm in diameter, dark brown to black, smooth, dotted abundantly with minute, punctate or elongate, whitish lenticels that do not break surface. **Internodes** 3–25 mm long on long shoots, 0.5–2 mm long on short shoots. **Cataphylls** (ramenta) distichous, produced at apex of shoots, somewhat congested, covering stem for 3–5 mm, 1.5–3 mm across, similar to foliar stipules, persisting, the spinule (leaf rudiment) 0.6–1 mm long, broad, flattened, dark brown or black. **Foliar stipules** persistent, appressed to stem, triangular-ovate, somewhat concave, 1.5–2.5 mm long, firmly membranaceous, distinctly striate-nerved with 3–5 nerves per side, pale green, turning ferruginous with age, apically obtuse or truncate, fimbriate, 3-setulose, the setae minute, 0.2–0.5 mm long, evanescent, the keels prominulous, sub-alate, the margin erose to markedly fimbriate, sometimes recurving in age. **Leaves** deciduous, produced along extension shoots or 1–2 at tips of short shoots, distichous, short-petiolate or subsessile, the lamina held horizontally, plane, variable in shape, broadly obovate, elliptic or orbicular, rounded or retuse at apex, obtuse or broadly cuneate at base, 18–35 mm long, 12–23 mm wide, membranaceous, adaxially medium green, abaxially very pale green, dull on both surfaces, elineate with no distinct central panel, the adaxial midrib a slender, low ridge, yellowish green, the lateral nerves 10–12, diverging 40°–60° from midrib, straight or somewhat sinuous, often parallel, anastomosing 1–2 mm from margin, the venation not pronounced on either surface. **Petiole** 1–2 mm long, 0.5 mm in diameter, subterete. **Flowers** produced

FIG. 4. *Erythroxylum maracasense*. **A,** flowering branch, 3-cm scale; **B,** fruiting branch, 3-cm scale; **C,** stipule, scale as in F; **D,** short-styled flower; **E,** long-styled flower; **F,** petal; **G,** endocarp; **H,** cross section of endocarp, scale as in G; **I,** embryo, scale as in G. (A, D, and F from *Gounelle s.n.*; B, G, H, and I from *dos Santos 3488*; C from *Plowman & Carvalho 12826*; E from *Martius s.n.*) Drawing by Marlene Werner.

FIG. 5. Habit of *Erythroxylum maracasense* growing near Maracás, Bahia (*Plowman & Carvalho 12826*).

in axils of cataphylls (ramenta) near tips of often very short, axillary short shoots, 1 or 2 flowers per node, not congested, the flower color unknown. **Bracteoles** oblong-ovate, concave, 0.7–0.9 mm long, membranaceous, the apex rounded and markedly fimbriate, the seta obscured. **Pedicel** slender, 5-ribbed, (1.2) 4–6 mm long, 0.4–0.5 mm in diameter, sometimes articulating with a very short peduncle 0.5–0.7 mm long. **Calyx** 1.5–2 mm long, divided ½–¾ its length, the lobes lanceolate to ovate-lanceolate, apically acute to acuminate, 0.7–1.8 mm long, the margins paler than the middle. **Petal** lamina somewhat concave, ovate to elliptic in outline, rounded and somewhat incurved at apex, 1.5–2.5 mm long, 1–1.5 mm wide, the claw 0.5–1 mm long, rather broad, the ligule 1 mm long, bilobed, each lobe consisting of a very short anterior auricle and a large posterior auricle, the

posterior one narrowly to broadly ovate, 0.6–0.8 mm long, with 3 broad, irregular teeth at apex. **Staminal cup** ¼–⅔ times length of calyx, 0.6–1 mm long, 10-crenulate or 10-denticulate at margin. **Brachystylous flowers:** filaments 2.5–2.8 mm long, the anthers ovate, 0.5 mm long; styles free, 1.5 mm long; stigmas depressed-captitate, 0.3 mm long. **Dolichostylous flowers:** antisepalous filaments 0.5–1 mm long, the anthers ovate-elliptic, 0.3–0.5 mm long; styles free, 2.5–3 mm long; stigma depressed-capitate, 0.2–0.3 mm long. **Ovary** ellipsoid or subglobose, rounded at apex, 1.2–2 times length of staminal cup, 1 mm long. **Drupe** in dried state oblong-ovoid, 6.5–8.5 mm long, 3.0–3.5 mm in diameter, red at maturity, the endocarp oblong-ovoid, acute at apex, terete in outline, markedly 6-sulcate, unilocular, the endosperm occupying ca. 50% of locule. **Embryo** 5.5 mm long; cotyledons broadly ovate, rounded at apex, subcordate at base, 4.5 mm long, 3 mm wide, 0.8 mm thick; radicle 1.3 mm long.

TYPE—Brazil, Bahia, Município de Maracás, rodovia BA-026, 15 km ao SW de Maracás, caatinga arbórea perturbada, folha SD-24 (14-40a), arvorezinha, 4 m de altura, comum, 17 Nov. 1978 (fl), *S. A. Mori, T. S. dos Santos & C. B. Thompson 11120* (holotype, CEPEC 15262; isotypes, F 1861962, F neg. 60124, K NY, RB).

ADDITIONAL SPECIMENS EXAMINED—**BRAZIL: Bahia:** Município de Cipó: entre Cipó e Ribeira do Pombal, 9 km adiante de Cipó na autoestrada, 19 Jan. 1964 (fl, young fr), *A. Leal Costa s.n.* (ALCB, F). Município de Maracás: "sylvis catingas ad Maracás," Oct. 1818 (fl), *C. F. P. von Martius* (M, F neg. 19468, excluded syntype of *E. pungens* O. E. Schulz); km 7 na estrada Maracás–Contendas do Sincorá, ca. 13°28'S, 40°29'W, alt. 850–900 m, 9 Feb. 1983 (st), *T. Plowman & A. M. de Carvalho 12826* (CEPEC, F, G, IPA, K, NY, RB, UB, US). Município de Jequié: entrada do ramal localizado ao SW do km 38 da rodovia Jequié–Contendas do Sincorá, Folha SD 24 (14-40a), 15 Feb. 1979 (fr), *T. S. dos Santos, L. A. Mattos Silva & H. da S. Brito 3488* (CEPEC, F, NY). **Goiás:** Near Almas, Oct. 1839 (fl), *G. Gardner 3054* (BM, K, OXF). **Minas Gerais(?):** "Caraça", [1885–1890], *P.-E. Gounelle s.n.* (P).

ETYMOLOGY—*Erythroxylum maracasense* is named for the town of Maracás in Bahia, near where the first and most of the subsequent collections of the species have been made.

DISTRIBUTION—This species is known primarily from east-central Bahia. One collection is from northern Goiás, and one southerly collection by Gounelle is from Caraça in Minas Gerais. The latter may be erroneously labeled. Gounelle was an engineer who made seven trips to Brazil, where he made extensive insect collections (Millot, 1920). He also collected plants, mainly during 1885–1890, in Minas Gerais and Bahia. That Gounelle collected plants elsewhere in northeastern Brazil is known, for example, by his collection during 1892–1893 of the type plant (living specimen?) of *Cephalocereus gounellei* (Weber) Britton & Rose, in Pernambuco (Schumann, 1903; Britton & Rose, 1937). Apparently not much care was taken in labeling Gounelle's plant specimens, and at least some localities (like the present case) appear to be incorrect (A. Lourteig, *in litt.*). At least one other monographer has noted discrepancies in distributions of species from northeastern Brazil collected by Gounelle and labeled "Caraça" (cf. *Banisteriopsis calcicola* Gates, cited in Gates [1982, p. 105]).

ECOLOGY—*Erythroxylum maracasense* is apparently confined to the caatingas of eastern Brazil. This formation is not found at Caraça in the area of Belo Horizonte where the Gounelle collection supposedly was made, which further supports the possibility that this specimen is mislabeled. At Maracás *E. maracasense* occurs sympatrically with several other erythroxylums, the first three of which are also caatinga endemics: *E. betulaceum* Mart., *E. macrochaetum* Miq., *E. polygonoides* Mart., *E. pelleterianum* St. Hil., and *E. subrotundum* St. Hil.

PHENOLOGY—This species has been collected in flower in October, November, and January; the sole fruiting specimen was gathered in February. Flowering undoubtedly follows the onset of the seasonal rains in the caatinga.

RELATIONSHIPS—*Erythroxylum maracasense* was first collected by Martius in 1818. Martius wrote on the label of his collection at M the name "*E. asparagoides* Mart.", indicating that he thought it was a new species. Subsequently, however, he crossed out his first annotation and identified the plant as *E. subrotundum* St. Hil. Although *E. subrotundum* belongs to a different section (sect. *Archerythroxylum*), it is a remarkable mimic for *E. maracasense* and also grows at Maracás.

Schulz (1907) included the Martius specimen as a syntype of his *E. pungens* O. E. Schulz. *Erythroxylum pungens,* also from caatinga, is a very different species characterized by thick, stiff, pointed ("pungent") branchlets, very long pedicels at the tips of the branchlets, and broadly ovoid, terete endocarps. Schulz's description better applies to the second syntype, *Blanchet 2771,* which collection I here designate as the lectotype of *E. pungens* O. E. Schulz (lectotype, G; isolectotypes, BM, E, G, LE, NY, W). Incidentally, Schulz also noted

TABLE 2. Morphological comparison of *Erythroxylum maracasense* Plowman and *E. pelleterianum* St. Hil.

Character	*E. maracasense*	*E. pelleterianum*
Twig surface	Dotted with lenticels	Lenticels absent or poorly developed
Stipule shape	Triangular ovate	Lanceolate
Stipule length (mm)	1.5–2.5	2.5–5
Ramenta	Poorly developed, to 4 mm long	Well developed, often covering twigs
Leaf shape	Elliptic, broadly obovate, or orbicular	Oblong elliptic or obovate
Leaf length (mm)	18–35	44–66
Endocarp	Terete in outline, 6-sulcate	Trigonal

the similarity of *E. pungens* (apparently referring to the leafless Martius specimen) to *E. subrotundum* St. Hil.

Another early collection of *E. maracasense, Gardner 3054,* was implicated erroneously as a syntype of another species, *E. subglaucescens* Peyr. ex O. E. Schulz. Schulz (1907) based his concept on Peyritsch's annotations (e.g., at W) and on a note published by Peyritsch (1878) under *E. virgultosum* Mart. in *Flora Brasiliensis.* Peyritsch cited *Gardner 3054* as a specimen similar to *E. virgultosum,* but suggested it might be a distinct species. It is now clear that Peyritsch misread the collection number on Gardner's handwritten label; Gardner's handwritten "6's" look like "4's." Peyritsch was actually studying *Gardner 3056* which matches his diagnosis for the species. Schulz (1907) published this species as *E. subglaucescens* and cited two specimens as syntypes: *Gardner 3054* and *3056.* I here select *Gardner 3056* as the lectotype (lectotype, W; isolectotypes, B, destroyed, F neg. 12648, BM, CGE, F, G, K, OXF, P), since it is this specimen with nonstriate stipules that Schulz described and placed in section *Archerythroxylum.*

Erythroxylum maracasense belongs to section *Rhabdophyllum* O. E. Schulz and is most closely related to *E. pelleterianum* St. Hil. These two species may be distinguished using the characters presented in Table 2.

4. **Erythroxylum mattos-silvae** Plowman, sp. nov. sect. **Rhabdophyllum** O. E. Schulz. Figures 6–8, 10.

Frutex vel arbuscula gracilis. Ramuli pauci, patentes, crassi. Cataphylla sparsa, remota, stipulis foliaribus similia. Stipulae foliares transverse triangulares, coriaceae, manifeste vel obscure striate nervosae, 2- vel 3-setulosae. Folia in ramulis dispersa, manifeste petiolata, persistentia; laminae amplae, oblongo-ellipticae vel oblongo-lanceolatae, plerumque ellipticae vel lanceolatae vel oblanceolatae, apice abrupte acuminatae, raro acutae vel obtusae, basi acuminatae vel cuneatae, subcoriaceae, ubique subnitidae. Flores e ramulis hornotinis vel annotinis in axillis foliorum vel cataphyllorum in axibus brevibus nati. Pedicelli valde incrassati, intus spongiosi, pallide virides vel ochracei, cum calyce conjuncti. Petali lamina ovata vel oblonga, cremea vel ochracea, ligula bilobata munita; ligula inter lobos appendice obconico-clavata, apice complanata, papillosa provisa. Urceolus stamineus calyce longior (× 1.5–2), margine eroso-crenulatus vel 5-denticulatus. In floribus brachystylis styli liberi; in floribus dolichostylis styli usque ad medium connati. Drupa oblongo-ellipsoidea, apice rotundata, endocarpio tereti, maturitate uniloculari.

Slender **shrub** or spindly **treelet** to 6 m tall, sparsely branched. **Trunk** slender, to 5 cm in diameter. **Bark** in younger plants rather smooth, light grayish brown, rather shiny, in older trees fissured longitudinally and transversely in concentric rings, dark grayish brown, ca. 3 mm thick, reddish within, the wood reddish tan. **Branches** more or less distant, spreading, in older trees occurring only near top and arching over, spreading, straight, reddish to grayish brown, more or less shiny. **Branchlets** few, thick, straight, diverging 40°–80° from axis, compressed toward apex, soon becoming terete, 3–4 mm in diameter, longitudinally wrinkled, shiny, reddish brown becoming light to dark grayish brown, with light brown, punctate lenticels that do not break surface. **Internodes** 3–25 mm long. **Cataphylls** (ramenta) sparse, 3–10 scattered along base of new shoots, similar to the stipules, the spinule (leaf rudiment) 1.2–1.5 mm long, black, apically curving away from axis. **Foliar stipules** persistent, distichous, diverging from stem up to 45°, transversely triangular, 2.5–3.5 mm long, prominently or obscurely striate-nerved with 5–8 nerves per side, coriaceous, pale green, turning dark brown on drying, the apex obtuse to truncate,

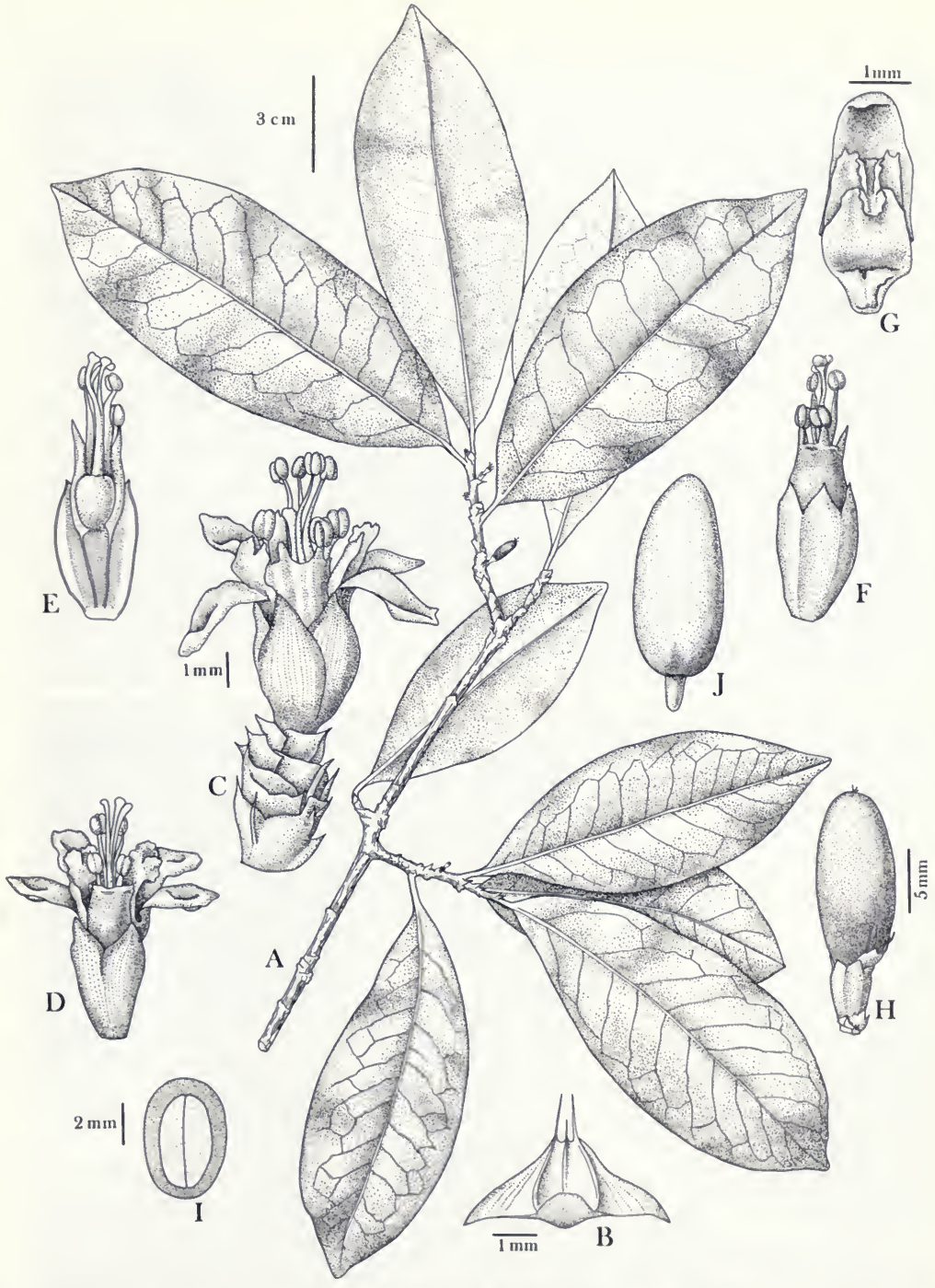

FIG. 6. *Erythroxylum mattos-silvae*. **A,** flowering branch; **B,** stipule; **C,** long-styled flower on short flowering axis, one petal removed; **D,** long-styled flower, one petal removed, scale as in C; **E,** cross section of long-styled flower showing thickened pedicel, scale as in C; **F,** "short-styled" flower showing same arrangement as long-styled flower, scale as in C; **G,** petal; **H,** drupe attached to calyx; **I,** cross section of drupe; **J,** embryo, scale as in I. (B, C, D, E, and G from *Plowman et al. 13970*; A, F, H, I, and J from *Plowman et al. 13965*.) Drawing by Marlene Werner.

FIG. 7. Habit of *Erythroxylum mattos-silvae* near Ilhéus, Bahia, Brazil (*Plowman et al. 13970*).

FIG. 8. Detail of flowering twig of *Erythroxylum mattos-silvae* (*Plowman et al. 13965*).

2- or 3-setulose, the 2 lateral setae short, subulate, 0.5–0.8 mm long, the medial seta filamentous, to 1 mm long, often evanescent or entirely lacking, the keels firm, slightly winged, the margin entire or minutely erose. **Leaves** persistent, scattered along younger branches, more or less distichous, petiolate, the lamina held horizontally, plane or slightly undulate, somewhat variable in shape, oblong-elliptic to oblong-lanceolate, sometimes elliptic, lanceolate or oblanceolate, at apex abruptly short-acuminate, rarely acute or obtuse, at base acuminate or cuneate, 90–270 mm long, 35–110 mm wide, subcoriaceous or rubbery, opaque, adaxially medium to dark green, somewhat shiny, drying blackish green, abaxially light green, shiny, drying dark green or ferruginous, elineate with no distinct central panel, the adaxial midrib prominulous, flat with a fine medial ridge or somewhat knife-edged, pale green, the midrib on both surfaces drying ferruginous, the lateral nerves 11–17 per side, diverging 55°–75° from midrib, straight, arcuately anastomosing 5–10 mm from margin, adaxially prominulous, abaxially faint to completely obscure. **Petiole** 5–15 mm long, subterete, adaxially canaliculate, drying dark brown or blackish. **Flowers** fasciculate in axils of leaves or cataphylls on current or year-old shoots; each inflorescence consisting of 1–10 short, indeterminate axes to 5 mm long and producing flowers sequentially. **Bracteoles** spiro-distichous, imbricate on flowering axes, transversely ovate, concave, 1–1.5 mm long, reddish brown, paleaceous, longitudinally striate-nerved, the apex acute to abruptly short-acuminate, with a minute, apical seta 0.2–0.4 mm long. **Pedicel** strongly thickened throughout its length and fused with the calyx, 5-angled, pale green or light yellow-ochre with pale green ribs, spongy-parenchymatous within, the pedicel together with calyx 3–3.5 mm long, 2.5 mm in diameter, elongating somewhat in fruit. **Calyx** lobes coriaceous, triangular to lanceolate, 0.5–1 mm long, the surface minutely striate, the apex acute to short-acuminate, the tip itself thin, drying light brown. **Petal** lamina spreading at anthesis, sometimes reflexed and lingulate, more or less plane, concave near apex, ovate to oblong, 2–2.4 mm long, 1–1.3 mm wide, ochreous in bud, greenish white to creamy white or ochreous at anthesis, rounded or truncate at apex, the claw 0.8–1 mm long, the ligule white, 1–1.2 mm long, bilobed, each lobe with a large posterior auricle and a short anterior auricle reduced to a cuff at base of posterior one, the posterior auricles ovate, 0.8–1 mm long, shallowly 3-lobed at apex, with a short, flaplike anterior appendage inflexed between the auricles and an erect, fleshy appendage between and slightly behind them, the posterior appendage obconic-clavate, flat and papillose at apex, nearly equaling the auricles. **Staminal cup** 1.5–2 times length of calyx, 1.3–2 mm long, greenish white, the margin finely erose or with 5 short teeth alternating with antisepalous filaments. **Mesostylous(?) flowers:** filaments in 2 series, the antisepalous filaments very short, subulate, erect, produced from cup margin, 0.6–0.7 mm long, the anthers orbicular, 0.5–0.6 mm in diameter; antipetalous filaments much longer, slender, produced from inner margin of cup, 1.8–2 mm long, inclined toward center, the anthers orbicular, slightly smaller, 0.4–0.5 mm in diameter; styles equaling or slightly longer than antisepalous stamens, 1–1.5 mm long, free or connate only at base; stigma minute, subcapitate, 0.3 mm long. **Dolichostylous flowers:** antisepalous filaments subulate, erect, produced from cup margin itself, 0.5–0.7 mm long, the anthers orbicular, 0.5 mm in diameter; antipetalous filaments slender, produced from inner margin of cup, 1.2–1.3 mm long, inclined toward center, the anthers orbicular, slightly smaller, 0.4 mm in diameter; styles 2.4–2.6 mm long, connate for 0.5–1.3 mm; stigmas minute, subcapitate, 0.2–0.3 mm long. **Ovary** obovoid or obconic, at apex rounded or truncate, ½–¾ times shorter than calyx, 1–1.5 mm long. **Drupe** oblong-ellipsoid, rounded at apex, 11–13 mm long, 5–6 mm in diameter, crimson at maturity, the mesocarp 0.7 mm thick, the endocarp ellipsoid in cross section, terete, unilocular with no endosperm. **Embryo** 10 mm long; cotyledons oblong-ovoid, 9 mm long, 3.5 mm wide, 1 mm thick; radicle 1.5 mm long.

TYPE—Brazil, Bahia, Município de Ilhéus, ramal novo para o povoado da Vila Brasil, com entrada no km 28 da rodovia Ilhéus–Una, início do ramal (km 3), lado direito, região de mata litorânea, solo argilo-silicoso, arbusto, 3,5 m de altura, flores esverdeadas, 13 Jan. 1985 (fl), *L. A. Mattos Silva, D. Daly & T. S. dos Santos 1817* (holotype, CEPEC 35860; isotypes, F 1943448, F neg. 60194, HRB, MBM, NY, RB).

ADDITIONAL SPECIMENS EXAMINED—**BRAZIL: Bahia:** Município de Ilhéus: ramal que liga a Rodovia BR-415 (Ilhéus–Itabuna) ao povoado de Japu, desvio à esquerda, coleta a 2 km da entrada, Fazenda Sultão, 17 Feb. 1982 (fl), *L. A. Mattos Silva, A. M. de Carvalho & T. S. dos Santos 1570* (CEPEC, F), 26 Feb. 1985 (st), *T. Plowman, L. A. Mattos Silva & T. S. dos Santos 13958* (CEPEC, F, NY, RB); Fazenda Barra do Manguinho, km 12 da rodovia Pontal–Olivença (BA-001), 27 Feb. 1985 (fl), *T. Plow-*

man, L. A. Mattos Silva & T. S. dos Santos 13970 (ALCB, B, CEPEC, F, G, GH, HRB, IPA, K, M, MBM, MO, NY, P, RB, SP, U, UB, UEC, US); ramal novo para o Povoado da Vila Brasil, com entrada no km 28 da Rodovia Ilhéus–Una, lado direito, início do ramal (km 3), 27 Feb. 1985 (fl), *T. Plowman, L. A. Mattos Silva & T. S. dos Santos 13960* (from the type tree) (CEPEC, F, K, NY, RB), início do ramal (km 7), 27 Feb. 1985 (fl), *T. Plowman, L. A. Mattos Silva & T. S. dos Santos 13965* (CEPEC, F, HUEFS, K, NY, RB, UB, US). Município de Una: estrada Ilhéus–Una, 19 Nov. 1983 (fl, young fr), *R. Callejas, A. M. de Carvalho & L. A. Mattos Silva 1755* (CEPEC, HBR, MBM, NY, RB); estrada que liga a Rodovia BR 101 (São José) com BA 215, a 17 km da entrada, 17 Jun. 1978 (fl), *S. Mori, F. Benton & I. White 10192* (CEPEC, F, K, NY, RB); 20 km north along the road from Una to Ilhéus, 39°02'W, 15°11'S, 23 Jan. 1977 (fl, fr), *R. M. Harley et al. 18183* (AAU, CEPEC, F, K, MO, NY, P, RB, U); km 48 da estrada Ilhéus–Una, 6 Mar. 1983 (fl), *A. M. de Carvalho & A. Chautems 1646* (CEPEC, F, G, HRB, HUEFS, K, NY); Fazenda São Rafael, 29 Oct. 1969 (fl), *T. S. dos Santos 450* (CEPEC, F, NY); rodovia Una–Xapuri, Dendhevea S.A., Fazenda Iguaçú, 29 Oct. 1971 (fl), *R. S. Pinheiro 1682* (CEPEC, F).

ETYMOLOGY—It is my pleasure to dedicate this species to Luiz Alberto Mattos Silva, curator of the CEPEC herbarium at the Centro de Pesquisas do Cacau, Ilhéus, Bahia, Brazil. Mattos Silva has made invaluable collections of the fast-disappearing native flora of southern Bahia, including several excellent collections of this species. He has also provided assistance and kind hospitality for myself and other botanists visiting southern Bahia.

DISTRIBUTION—*Erythroxylum mattos-silvae* is confined to a small area along the coast of Bahia, Brazil, from Ilhéus south to Una.

ECOLOGY—This species apparently grows only in the "restinga arborea," or restinga forest, a forest of low stature growing on sandy soils near the coast. It has not been found in open restinga formations. Just south of Ilhéus, it grows in restinga forest in association with the piaçava palm (*Attalea funifera* Mart.) in areas of disturbed or secondary vegetation. But further south along the new road to Vila Brasil, this species occurs in a somewhat taller forest on mixed sandy/clay soil, which possibly represents a transition from restinga to the tropical moist forest of southern Bahia. However, *E. mattos-silvae* has not been found in typical "mata higrófila." The plants occur as erect, almost columnar shrubs, or as tall, spindly trees with thin trunks and with most of the branches and leaves at the top. The habit may relate only to the age of the plant or possibly to local edaphic conditions. The plants are occasional or rare in the few localities where they are known. Nevertheless, it is surprising that this remarkable species was first collected only in 1969, having been overlooked by the numerous botanists who have worked around the city of Ilhéus since the early 1800s.

PHENOLOGY—Most flowering collections of *E. mattos-silvae* have been made between October and March, but it was also found flowering in June. Because the flowers in each cluster are produced sequentially, it is likely that the flowering period for a given individual or population is quite prolonged.

RELATIONSHIPS—In a preliminary list of *Erythroxylum* species in southern Bahian moist forests (Mori et al., 1983), I identified one specimen (*Harley et al. 18183*) of this species as *Erythroxylum* aff. *magnoliifolium* St. Hil. of sect. *Megalophyllum* O. E. Schulz. Closer observation of this and subsequently collected material shows that *Erythroxylum mattos-silvae* belongs to section *Rhabdophylum,* based on its striately nerved stipules, and is unrelated to *E. magnoliifolium.*

The ochre-colored pedicel, calyx, and petals of *E. mattos-silvae* have been observed only in one other species, *E. tenue* Plowman, which occurs sympatrically with *E. mattos-silvae* and belongs to the same section. The two species seem otherwise only distantly related. The possible significance of this distinctive flower color for pollination is unknown.

With its relatively large subcoriaceous leaves and small, subsessile flowers, *E. mattos-silvae* may be confused with a number of other coastal Bahian species of *Erythroxylum.* Comparisons of this species with five others that superficially resemble it are presented in Table 3.

In the relatively small sample of existing collections of this species, two floral morphs were found. The long-styled morph with long styles and two shorter whorls of stamens is normal and comparable to long-styled flowers of most other *Erythroxylum* species. However, the second morph in this species, observed in four collections, is in fact a mid-styled morph with one whorl of stamens shorter and one longer than the styles. This is very unusual and has been reported only in one other species, *E. lucidum* Moon (= *E. acuminatum* [Arn.] Walp.) from Sri Lanka (Burck, 1895). The mid-styled floral morph may be only a structural anomaly; however, there is the possibility that a short-styled morph also exists, in which case *E. mattos-silvae* would be a tristylous species. Burck (1895) suggested that *Erythroxylum* species are in fact tristylous plants that are in evolutionary transition to distyly (Ganders, 1979). Further field-

TABLE 3. Morphological comparison of *Erythroxylum mattos-silvae* Plowman, *E. nobile* O. E. Schulz, *E. compressum* Peyr., *E. membranaceum* Plowman, *E. martii* Peyr., and *E. grandifolium* Peyr.

Character	*E. mattos-silvae*	*E. nobile*	*E. compressum*	*E. membranaceum*	*E. martii*	*E. grandifolium*
Leaf apex	Abruptly short-acuminate, rarely acute or obtuse	Obtuse to rounded, rarely acute	Long-acuminate, falcate	Rounded	Short- to long-acuminate	Acuminate
Stipule nerves	Striate-nerved	Striate-nerved	Striate-nerved	Striate-nerved	Estriate	Estriate
Stipule length (mm)	2.5–3.5	4–8	1.5–3	2–2.5	7–17	2.5–3.0
Pedicel thickened	Yes	Yes	No	No	No	Yes
Drupe length (mm)	11–12	11–13	10	9–10	17	8–15
Endocarp cross section	Terete	Terete	Terete	Terete	Trigonal	Trigonal

work is necessary to confirm or refute the existence of a third-style morph and to determine the significance of this deviation from the normal distylous pattern of Neotropical *Erythroxylum*.

5. **Erythroxylum membranaceum** Plowman, sp. nov. sect. **Rhabdophyllum** O. E. Schulz. Figures 9–10.

Frutex. Ramuli recti, lenticellis elongatis abundanter producti. Cataphylla saepe congesta, stipulis foliaribus similia. Stipulae foliares persistentes, parvae, manifeste striate nervosae, 3-setulosae. Folia persistentia, petiolata; laminae amplae, oblongae vel ellipticae, apice rotundatae vel retusae, basi late cuneatae, firme membranaceae. Flores 1–3 e ramulis hornotinis in axillis ramentorum nati, pedicellis tenuibus. Urceolus staminеus calycem aequans, margine 10-denticulatus, decem glandulis rotundis parvis instructus. In floribus brachystylis styli liberi. Drupa ovoideo-ellipsoidea, apice obtusa, endocarpio oblongo-ellipsoideo, tereti, maturitate uniloculari, endospermio nullo. Embryo magnus, cotyledonibus late ellipticis, apice rotundatis.

Shrub 3 m tall. **Branches** erect to spreading, terete, dark brown. **Branchlets** erect to spreading, straight, diverging 20°–60° from axis, compressed at apex, 2 mm in diameter, dark reddish brown, smooth, furnished with elongate, light tan lenticels. **Internodes** 4–15 mm long. **Cataphylls** (ramenta) produced at base of shoots for 8–12 mm along stem, often congested, diverging slightly from axis, similar to foliar stipules, 1.5–2.5 mm long. **Foliar stipules** persistent, appressed to stem, erect, triangular to ovate, 2–2.5 mm long, firmly membranaceous, distinctly striate-nerved with 6–8 nerves per side, at apex obtuse to acute, 3-setulose, the medial seta 0.5 mm long, the lateral setae 0.3–0.4 mm long, the keels prominent, entire, the margin entire. **Leaves** persisting 1 or 2 seasons, scattered on branchlets, petiolate, the lamina plane, oblong-elliptic, rounded at apex, sometimes briefly retuse, broadly cuneate at base, 50–125 mm long, 33–60 mm wide, firmly membranaceous, drying grayish green adaxially, light brownish abaxially, more or less shiny on both surfaces, abaxially elineate with a faintly distinct central panel demarcated by more prominent and regular venation, the adaxial midrib furrowed, the abaxial midrib prominent, drying dark reddish brown, the lateral nerves 8–12 per side, diverging 50°–60° from midrib, rather straight or arcuately curved, slightly impressed adaxially, prominulous abaxially, the veinlets finely reticulate, obscure adaxially, prominulous abaxially. **Petiole** 5–6 mm long, 1–1.5 mm in diameter, drying dark brown, subterete in cross section, adaxially canaliculate. **Flowers** 1–3 in axils of last season's cataphylls, the flower color unknown. **Bracteoles** persistent, broadly triangular, concave, striate-nerved with 1 oblique keel and 2–3 nerves per side, acute to rounded at apex, the seta 0.1–0.2 mm long. **Pedicel** slender, pentangular and 5-ribbed, 3–7 mm long, 0.5 mm in diameter. **Calyx** 1.5 mm long, divided ½–⅔ its length, the lobes triangular-ovate, 0.9–1 mm long, acute to acuminate at apex. **Petals** not seen. **Staminal cup** equaling the calyx, 1 mm long, bearing 10 small, round, surface glands alternating with the filaments, the margin 10-denticulate. **Brachystylous flowers:** filaments 2–2.3 mm long, the anthers not seen; styles free, 1 mm long; stigma minute, de-

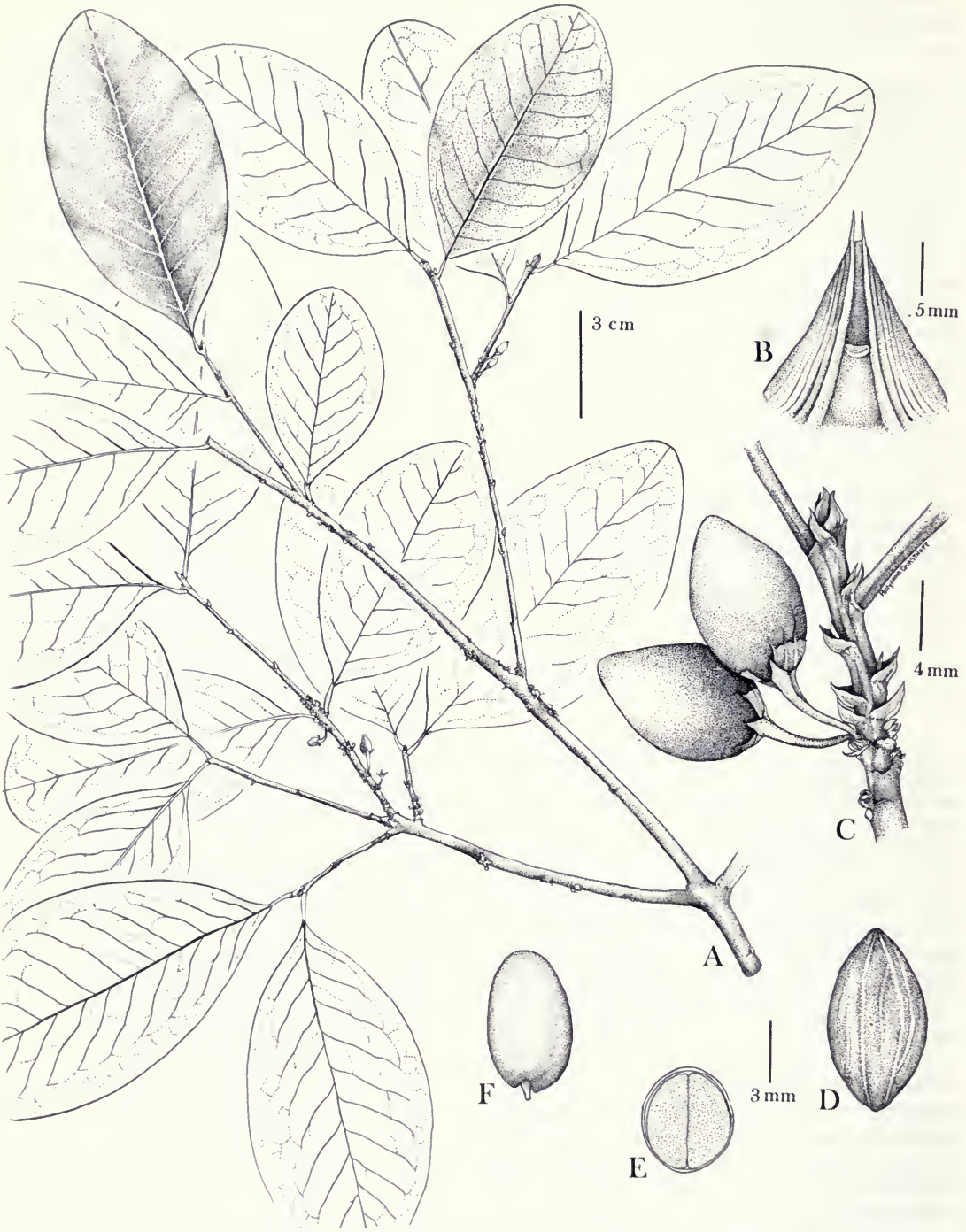

FIG. 9. *Erythroxylum membranaceum.* **A,** fruiting branch; **B,** stipule; **C,** detail of fruiting twig; **D,** endocarp; **E,** cross section of endocarp, scale as in D; **F,** embryo, scale as in D. (All from the type, *Belém & Magalhães 932.*) Drawing by Pollyanna Quasthoff.

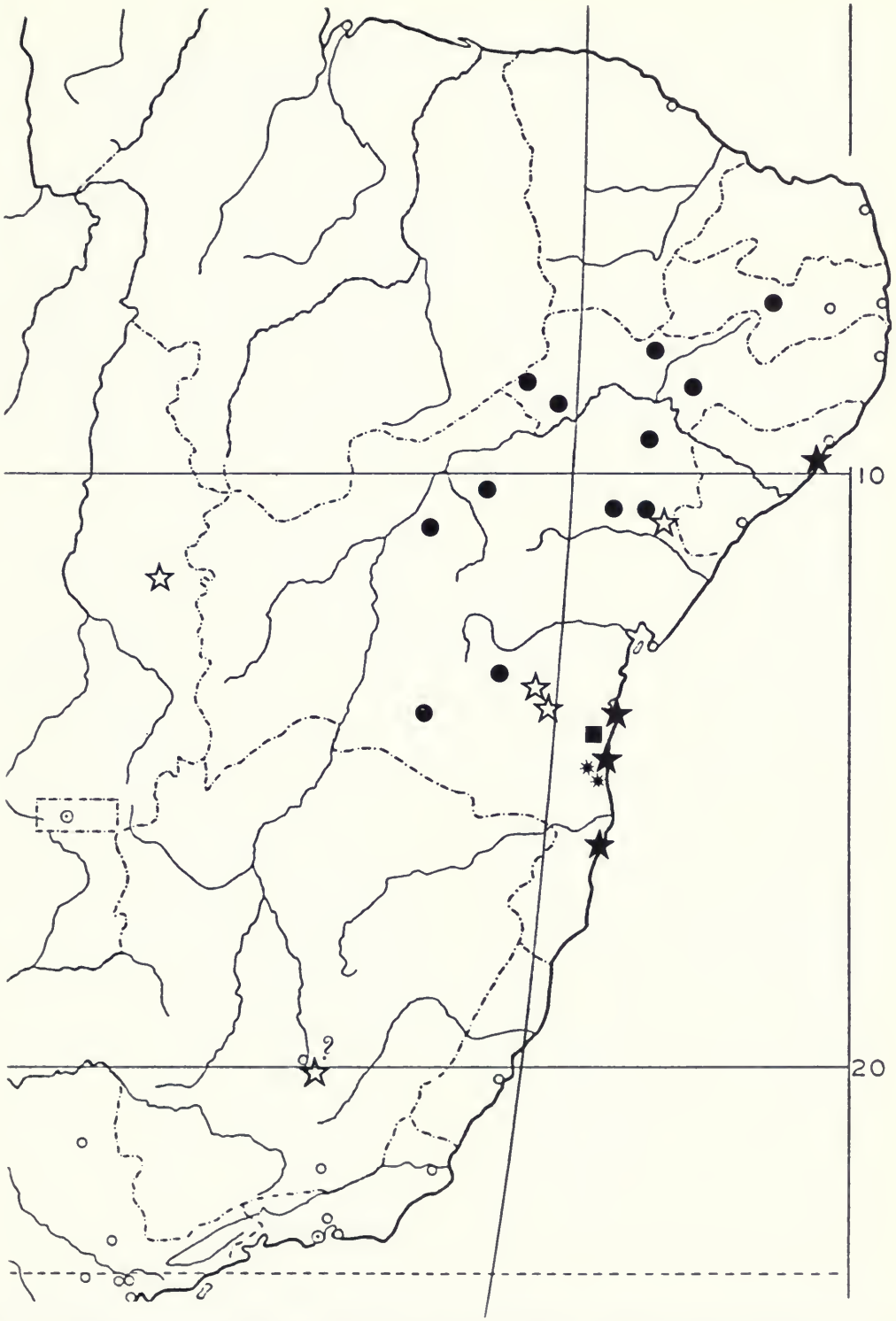

FIG. 10. Known geographical distribution of new *Erythroxylum* species in eastern Brazil. Solid stars = *E. andrei*; solid circles = *E. caatingae*; open stars = *E. maracasense*; small, 8-pointed stars = *E. mattos-silvae*; solid square = *E. membranaceum*.

pressed-capitate, 0.2 mm long. **Dolichostylous flowers:** not seen. **Ovary:** not seen. **Drupe** ovoid-ellipsoid, obtuse at apex, 9–10 mm long, 5–6 mm in diameter, the mesocarp ca. 0.2 mm thick, the endocarp ovoid, terete, obtuse or broadly acute at apex, unilocular, with little or no endosperm. **Embryo** 7.3 mm long; cotyledons broadly elliptic, rounded at apex, subcordate at base, 6.7 mm long, 4.2 mm wide, 1.3 mm thick; radicle 1–1.5 mm long.

TYPE—Brazil, Bahia, Município Aurelino Leal, rodovia Ubaitaba–Lages [= Lage do Banco], 8 km de Ubaitaba, mata virgem e perigosa [*sic*], planta de 3 m de altura, frutos verdes, 24 Apr. 1965 (fr), *R. P. Belém & M. Magalhães 932* (holotype, CEPEC 1057, F neg. 60130; isotypes, F 1622274, F neg. 60188, IAN 119424, NY, UB).

ETYMOLOGY—From Latin *membranaceus* meaning "membranaceous," in reference to the thin leaves of this species.

DISTRIBUTION—Southern Bahia, known only from the type collection.

ECOLOGY—This species is apparently a local endemic in the moist forests of southern Bahia, where at least 10 other endemic species of *Erythroxylum* are known to occur (Mori et al., 1983).

PHENOLOGY—The sole collection was gathered with fruit in late April.

RELATIONSHIPS—*Erythroxylum membranaceum* belongs to section *Rhabdophyllum* O. E. Schulz. It appears to be related to a number of species of eastern Brazil in which the striately nerved stipules are relatively small and persistent. It differs from *E. distortum* Mart. and *E. tenue* Plowman, both of which are endemic in the same general area as *E. membranaceum,* in the much larger leaves and stouter branchlets. *Erythroxylum compressum* Peyr., known from moist forests south of Ilhéus, differs in the strongly compressed branchlets, subsessile, oblong-lanceolate, apically acuminate leaves, and a staminal tube much shorter than the calyx. *Erythroxylum affine* St. Hil. *non* A. Rich. (syn. *E. blanchetii* O. E. Schulz) is known from Bahia (without locality) south to Espírito Santo and Cabo Frio in the state of Rio de Janeiro. It differs from *E. membranaceum* in having thicker, shorter (40–78 mm long vs. 50–125 mm long), apically acuminate leaves, in which the adaxial midrib is prominent and markedly acute in cross section. In *E. membranaceum* the adaxial midrib is a furrow sunken in the leaf surface. *Erythroxylum membranaceum* is compared with other large-leaved species from southern Bahian moist forests in Table 3.

6. **Erythroxylum petrae-caballi** Plowman, sp. nov. sect. **Rhabdophyllum** O. E. Schulz. Figures 11, 18.

Frutex vel arbor parva, ramulis rectis vel flexuosis, tegumento cereo obtectis et lenticellis instructis. Cataphylla pauca, disticha, stipulis foliaribus similia. Stipulae foliares persistentes, parvae, triangulari-ovatae, striate nervosae, breviter 3-setulosae. Folia parva, breviter petiolata, decidua; laminae ellipticae vel oblongae, raro lanceolatae, apice obtusae vel rotundatae, mucronulatae, basi acutae vel obtusae, chartaceae, supra nitidae, subtus impolitae. Flores e ramulis annotinis vel hornotinis in axillis foliorum vel ramentorum nati. Petali lamina oblongo-ovata, ligula bilobata munita. Urceolus stamineus quam calyx dimidio brevior, margine integer. Styli liberi. Drupa endocarpio ampullaceo, tereti, uniloculari, endospermio nullo, embryone magno et crasso provisa.

Shrub 1.5–3 m tall or tree to 9 m tall, densely or openly branched. **Branchlets** more or less distichous, undifferentiated into short shoots, diverging 40°–70° from axis, more or less flexuous, compressed at apex when young, 1–1.5 mm in diameter, smooth, reddish brown, soon becoming covered with a thin, whitish wax coating which sloughs off with age, the lenticels punctate or elongate, whitish, the bark becoming light brown, longitudinally striate with age. **Internodes** 0.5–15 mm long. **Cataphylls** (ramenta) distichous, produced at base of new twigs, few, scattered, in form similar to foliar stipules, rarely more developed, overlapping and covering stem for 3–10 mm, 2.5 mm wide, the spinule (leaf rudiment) 0.8–2 mm long, flattened, black, sharp-attenuate at apex. **Foliar stipules** persistent, appressed to stem, diverging only slightly with age, triangular-ovate, 1.7–2.5 mm long, subcoriaceous, striate-nerved with 4–6 nerves per side, light green, turning ferruginous in age, obtuse or acute at apex, 3-setulose, the setae thin-filamentous, turning black and spreading, 0.2–0.7 mm long, the medial seta a little longer or shorter than 2 equal lateral ones, the setae evanescent, the keels sub-alate, the margin erose. **Leaves** deciduous or briefly persistent, scattered along branchlets, distichous, short-petiolate, the lamina plane, elliptic to oblong, rarely lanceolate, obtuse to rounded at apex, mucronulate, acute to obtuse at base, 20–65 mm long, 10–30 mm wide, chartaceous, adaxially drying gray-green, shiny, abaxially drying very pale green to ochreous, matte, elineate with no distinct central panel, the adaxial midrib shallowly furrowed, rarely flat, the abaxial midrib drying straw-colored or ochreous, the lateral nerves 9–12, diverging 45°–80° from midrib,

FIG. 11. *Erythroxylum petrae-caballi*. **A,** flowering branch; **B,** leaf showing venation; **C,** stipule, scale as in E; **D,** short-styled flower; **E,** petal; **F,** petal, scale as in E; **G,** drupe, scale as in H; **H,** cross section of endocarp; **I,** embryo, scale as in H. (A, B, D, and E from *Grupo Pedra do Cavalo 967*; C and F from *Grupo Pedra do Cavalo 987*; G, H, and I from *Noblick & Hahn 3361*.).

rather straight or crooked, anastomosing 1–4 mm from margin, scarcely evident on either surface. **Petiole** 2–4 mm long, 0.5–0.7 mm in diameter, suberect, broadly canaliculate. **Flowers** 1–3, produced sequentially in axils of cataphylls or leaves on current or last season's twigs, rather sparse, "yellow." **Bracteoles** transversely ovate or transversely triangular, concave, 0.8–1 mm long, obtuse or acute at apex, the seta 0.1–0.3 mm long. **Pedicel** slender, 2–11 mm long, 0.5 mm in diameter, subterete or pentagonal, 5-ribbed, in fruit sometimes articulating with a short, persistent peduncle 0.5–1.5 mm long. **Calyx** 1.3–1.8 mm long, divided ½–¾ its length, the lobes ovate to triangular, 0.7–1.1 mm long, acute to attenuate at apex, the tip itself drying dark brown. **Petal** lamina oblong-ovate, concave and rounded at apex, 1.2–1.5 mm long, 0.8–1 mm wide, the claw 0.5–1 mm long, the ligule with 2 simple, ovate auricles, 0.5–0.6 mm long, with a short, sometimes inflated posterior-medial lobe and a broad, truncate, anterior flap inflexed between the auricles. **Staminal cup** ½ the length of calyx, 0.6–0.8 mm long, the margin entire. **Brachystylous flowers:** all filaments subequal, ca. 1.5 mm long; or antisepalous filaments shorter, 1–1.2 mm long, the antipetalous filaments 1.1–1.7 mm long; anthers orbicular, 0.4 mm long; styles free, 0.5–0.7 mm long; stigma depressed-capitate, 0.2 mm long. **Dolichostylous flowers:** not seen. **Ovary** ovoid or ellipsoid, rounded at apex, 1.5–1.8 times length of staminal cup, 0.8–1.2 mm long. **Drupe** flask-shaped, 9 mm long, 5.5 mm in diameter, red, the mesocarp ca. 0.3 mm thick, the endocarp ovoid, flask-shaped, acute at apex, terete, smooth, unilocular, lacking endosperm. **Embryo** 6.5–8 mm long; cotyledons elliptic, rounded at apex, cordate at base, 5.5–7 mm long, 4.5–5 mm wide, 1.5 mm thick; radicle 1.4 mm long.

TYPE—Brazil, Bahia, Cachoeira, Vale dos Rios Paraguaçu e Jacuípe, ca. 39°05'W, 12°32'S, alt. 40–120 m, Morro Belo, árvore con cerca de 9 m de altura; folhas elíticas e com frutos, Dec. 1980 (fl, imm fr), *Grupo Pedra do Cavalo* (*Scardino, Noblick, Paranhos, Guedes, Queiróz, Paganucci, Nascimento, Suely, Quaglia*) *967* (holotype, CEPEC 26980; isotypes, ALCB 8103, BAH 2984, BOTU, F, HRB 7253, HUEFS 1026, MBM, RB, SP).

ADDITIONAL SPECIMENS EXAMINED—**BRAZIL: Bahia:** Município de Cachoeira: Cachoeira, Vale dos Rios Paraguaçu e Jacuípe, ca. 39°05'W, 12°32'S, alt. 40–120 m, Estação da Mata, Jun. 1980 (imm fr), *Grupo Pedra do Cavalo 293* (ALCB), same locality, Jun. 1980 (fl bud), *Grupo Pedra do Cavalo 811* (ALCB, BAH, BOTU, CEPEC, F, HRB, HUEFS, RB, SP); Morro Belo, Aug. 1980 (fl), *Grupo Pedra do Cavalo 504* (ALCB, BAH, BOTU, CEPEC, F, HRB, MBM, RB), same locality, Dec. 1980 (fl bud), *Grupo Pedra do Cavalo 987* (ALCB, BAH, CEPEC, HRB, HUEFS). Município de Feira de Santana: Serra de São José, Fazenda Boa Vista, 12°15'S, 38°58'W, 24 May 1984 (fr), *L. R. Noblick 3271* (CEPEC, F, HUEFS), same locality, 9 Jun. 1984 (fr), *L. R. Noblick & W. J. Hahn 3361,* (CEPEC, F, HUEFS, K, MO).

ETYMOLOGY—The specific epithet "petrae-caballi" is a Latin rendering (genitive form) of the Portuguese *Pedra do Cavalo,* "horse's rock." This is the name taken by the group of botanists who collected most of the material of this species in the area of the new hydroelectric dam on the Rio Paraguaçu known as Pedra do Cavalo. The name Pedra do Cavalo originally referred to a rock outcrop, now destroyed, that extended into the Rio Paraguaçu, where cowboys used to take their horses to drink and to be washed (Geraldo Pinto and Larry Noblick, *in litt.*). The Pedra do Cavalo collectors, based at the Universidade Federal da Bahia in Salvador and headed by Lectícia Scardino Scott Faria, have conducted a floristic-ecological study of the area to be inundated by the Pedra do Cavalo Dam.

DISTRIBUTION—*Erythroxylum petrae-caballi* is known only from the municipalities of Feira de Santana and Cachoeira in eastern Bahia.

ECOLOGY—This species grows in seasonally dry, deciduous forest, especially in forest clearings and along small seasonally dry creeks in the forest. Larry R. Noblick of the Universidade Estadual de Feira de Santana supplied the following descriptions of the habitats of this species in two areas where it has been collected.

1) Serra de São João, ca. 22 km north northwest of Feira de Santana: "This is a seasonal, deciduous forest that usually undergoes a definite dry season, especially from the end of September through January. Within this forest, *E. petrae-caballi* grows preferentially in the valleys of temporary streams. Annual rainfall is around 800 mm. The main forest is on a north-facing slope. The forest canopy is about 20–25 m tall. Some dominant tree species are *Cavanillesia arborea, Cnidoscolus marcgravii, Goniorrhachis marginata, Cedrela odorata, Gallesia gorazema,* and *Chorisia* sp. The shrubby understory includes, in addition to *Erythroxylum petrae-caballi, Urera baccifera, Cordia superba,* and species of *Phyllanthus, Psychotria,* and *Clavija.* The herbaceous layer includes the grass *Raddia portoi* and species of *Tripogandra, Tinantia,* and *Dichorisandra* of the Commelinaceae. A few cactus species are scattered here and there; scattered

TABLE 4. Morphological comparison of *Erythroxylum petrae-caballi* Plowman, *E. tenue* Plowman, *E. distortum* Mart., *E.* cf. *mikanii* Peyr., and *E. passerinum* Mart.

Character	*E. petrae-caballi*	*E. tenue*	*E. distortum*	*E.* cf. *mikanii*	*E. passerinum*
Short shoots	Absent	Absent	Present	Present	Present
Stipular setae	3	2	3	3	3
Leaf shape	Elliptic to oblong	Ovate to lanceolate	Elliptic to obovate	Elliptic	Elliptic to lanceolate
Leaf apex	Rounded, obtuse	Acute	Rounded, retuse	Rounded, retuse	Acute to rounded
Adaxial midrib	Canaliculate	Knife-edged	Knife-edged	Knife-edged	Canaliculate with fine medial ridge
Petal ligule	Not thickened	Thickened, reduced	Not thickened	Not thickened	Not thickened
Pairs of auricles on ligule	1	1	2	2	2
Staminal cup vs. calyx	Shorter	Longer	Longer	Shorter	Shorter
Styles connate	No	Yes	No	No	No
Endocarp shape	Ampullaceous-terete	Ovoid-terete	Ellipsoid-terete	Ovoid- or oblongoid-terete	Oblong-ellipsoid, 6-sulcate

ferns are found on the moister upper slopes. The soil is shallow and extremely rocky; the soil itself is sandy mixed with a significant amount of humus."

2) Pedra do Cavalo area: "The forests of the Pedra do Cavalo area are essentially the same. Morro Belo contains a seasonal, deciduous forest with *Cavanillesia arborea* as one of the most conspicuous tree species. The 'Estação de Mata' locality is perhaps a bit more humid since it is closer to the coast and with soil containing a bit more clay. Nevertheless, *Cavanillesia arborea* was present here, as were *Cnidoscolus marcgravii* and *Erythrina velutina,* etc.

"All of these areas have the same type forest: seasonally deciduous to semi-deciduous with a mixture of tree species from the Atlantic coastal forest and the caatinga" (L. Noblick, *in litt.*).

PHENOLOGY—Flowering specimens have been collected in June, August, October, and December; fruiting specimens, in May and June.

RELATIONSHIPS—*Erythroxylum petrae-caballi* belongs to sect. *Rhabdophyllum.* It resembles several other species in this large and diverse section; these species form a poorly defined, complex group whose center of diversity is the state of Bahia. They all have small, relatively thin leaves, small, striately nerved stipules, and small flowers produced on the new twigs. The species differ mainly in the size and form of stipules and number of setae, form of cataphylls, leaf persistence, shape and form of the adaxial midrib, relative lengths of calyx and staminal tube, form of the petal ligule, connation of the styles, and form of the endocarp. In spite of striking similarities in one or more of these characters, the species of this group usually are ecologically specialized in different vegetation types, soils, and microclimates.

Three species that appear most closely related to *E. petrae-caballi* are *E. distortum* Mart., *E. tenue* Plowman (described below), and *E. mikanii* Peyr. The last species is positively known only from the sterile unicate type (preserved at W) collected by Mikan in the state of Rio de Janeiro at "Tocaja" (cf. Mikan, 1837). "Tocaja" is an old spelling corresponding to Rio Itocáia, Pedra de Itaocáia, or Itaocáia, all of which are located near the present-day town of Itaipu-Açu. This is an area of restinga and restinga forest, now largely destroyed for beachfront housing, on the coast southeast of the city of Niterói.

There is a species locally common in coastal Bahian restinga forests (cf. *Araujo 22, Plowman & Carvalho 12817, Plowman et al. 13959, 13969)* that closely resembles *E. mikanii,* but its identity has not been established with certainty. This plant also may prove to be a distinct undescribed species. *Erythroxylum petrae-caballi* is compared to these species (including the Bahian plants of *E.* cf. *mikanii*) in Table 4.

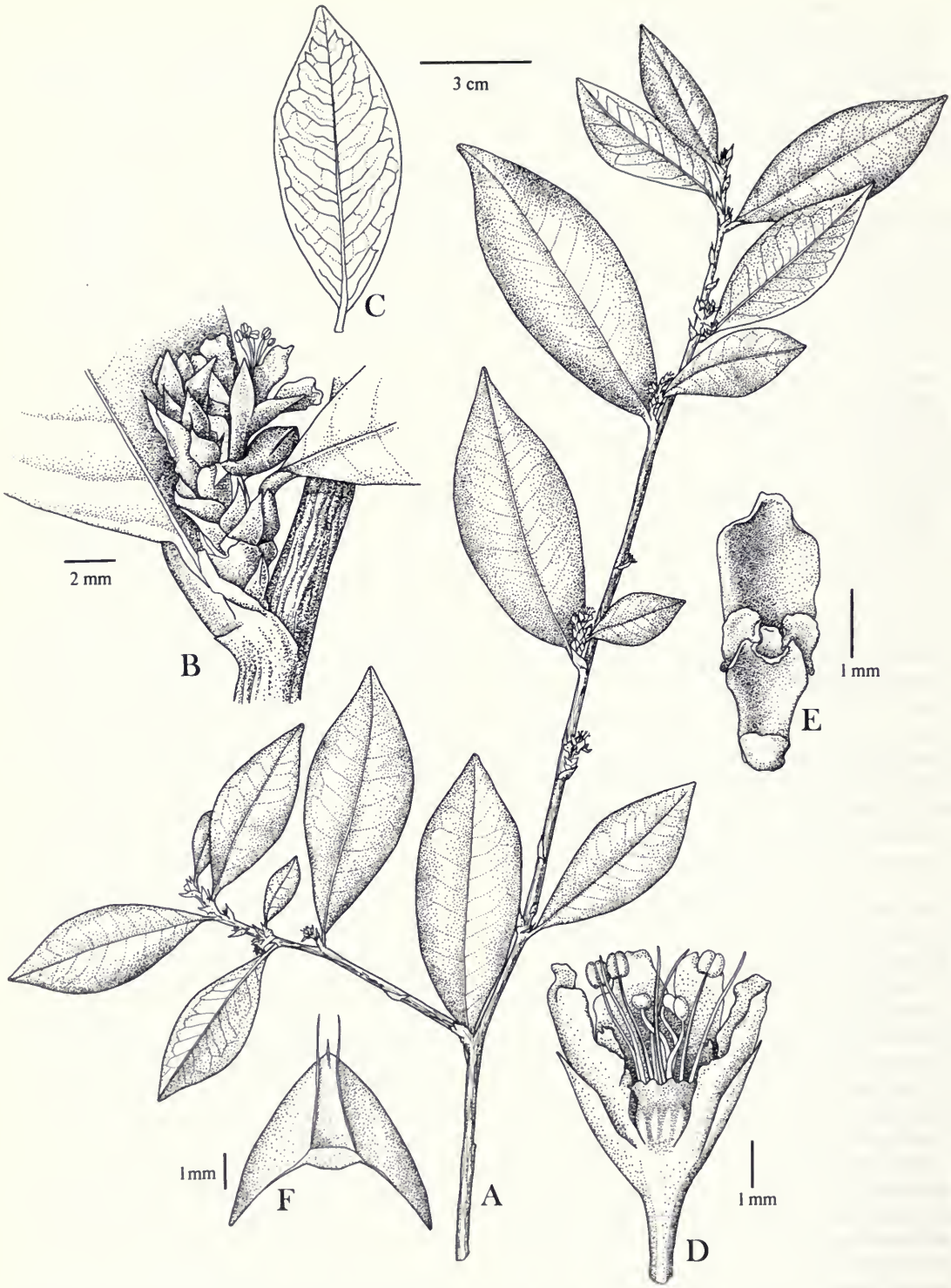

FIG. 12. *Erythroxylum santosii*. **A,** flowering branch, 3-cm scale; **B,** detail of flowering axillary short-shoot; **C,** leaf showing venation, 3-cm scale; **D,** short-styled flower; **E,** petal; **F,** stipule. (All from the type, *dos Santos 1618*.) Drawing by Marlene Werner.

7. **Erythroxylum santosii** Plowman, sp. nov. sect. **Archerythroxylum** O. E. Schulz. Figures 12, 18.

Frutex. Cataphylla pauca, stipulis foliaribus similia. Stipulae foliares persistentes, late ovatae, subcoriaceae, estriatae, brunnescentes, 2(–3)-setulosae. Folia breviter petiolata; laminae oblongae vel lanceolatae vel oblanceolatae, apice acutae vel breviter acuminatae, ipso apice obtusae, basi cuneatae vel obtusae, firme chartaceae, opacae. Flores e ramulis hornotinis in axillis cataphyllorum nati, pedicellis brevibus, recurvatis. Petali lamina oblonga. Urceolus stamineus tribus quintis partibus longitudinis calycis aequalis, margine irregulariter 10-denticulatus. Styli liberi. Drupa ignota.

Shrub 2 m tall. **Branchlets** weakly differentiated into long and short shoots, diverging 40°–80° from axis, somewhat compressed at apex, 2 mm in diameter, light brown, smooth, becoming lightly suberose-verruculose but without lenticels breaking surface. **Internodes** on long shoots 5–25 mm long, on short shoots 1–1.5 mm long. **Cataphylls** (ramenta) 3–4, scattered along base of long shoots or congested at tips of short shoots, similar to foliar stipules, the spinule (leaf rudiment) 1.5–2 mm long, black. **Foliar stipules** persistent, appressed to stem, diverging slightly in age, broadly ovate, 3–4 mm long, subcoriaceous, smooth, nonstriate, drying dark brown or black, rounded at apex, 2(–3)-setulose, the 2 lateral setae 0.5–1 mm long, sometimes with a short, medial seta to 0.5 mm long, evanescent, the keels sub-alate, the margin entire. **Leaves** persistent, scattered along long shoots or 1 (2) produced at tip of short shoots, distichous, short-petiolate, the lamina plane, oblong, lanceolate or oblanceolate, acute or short-acuminate at apex, the apex itself blunt, cuneate to obtuse at base, 40–90 mm long, 20–35 mm wide, firmly chartaceous, opaque, drying adaxially chestnut-brown, abaxially ochreous to ferruginous, dull on both surfaces, elineate with no distinct central panel, the adaxial midrib yellowish brown with a slender, slightly raised, knife-edged medial ridge, the lateral nerves 9–11, diverging 50°–80° from midrib, curved and arching upward, anastomosing 3–4 mm from margin, the veinlets obscure. **Petiole** 2–3 mm long, 1 mm in diameter, amply canaliculate. **Flowers** in axils of cataphylls on mature extension shoots or short shoots, the petals yellow. **Bracteoles** lanceolate in outline, cymbiform, 1.5 mm long, acute at apex, the seta 0.5–0.7 mm long. **Pedicel** recurved, 5-angled, 1.5–2 mm long, 0.8 mm in diameter, slightly thickened at apex. **Calyx** 2.5 mm long, divided nearly to base, drying black, the lobes lanceolate, 2 mm long, narrowly acute at apex. **Petal** lamina somewhat concave, oblong, rounded at apex, 2.5 mm long, 1.5 mm wide, the claw 1.5 mm long, the ligule 1 mm long, bilobed with a pair of suborbicular auricles 0.8 mm long, with an erect, medial lobe or flap, nearly equaling the auricles between and immediately posterior to the auricles. **Staminal cup** ⅗ as long as calyx, 1.5 mm long, drying dark brown with 10 light-colored, longitudinal markings, the margin minutely and irregularly 10-denticulate. **Brachystylous flowers:** filaments white, 2.5 mm long, the anthers suborbicular, 0.5–0.6 mm long; ovary equaling staminal cup, ovoid, 1.2 mm long, at apex rounded-truncate; styles free, 1.7 mm long; stigmas depressed-capitate, 0.4 mm long. **Dolichostylous flowers:** unknown. **Drupe:** unknown.

TYPE—Brazil, Bahia, Vale do Rio Alcobaça [= Rio Itanhém], Teixeira de Freitas, arbusto de 2 m de alt, flor amarelada, estames brancos, mata, 12 May 1971 (fl), *T. S. dos Santos 1618* (holotype, CEPEC 6910; isotype, F 1839581, F neg. 60125).

ETYMOLOGY—*Erythroxylum santosii* is named for Talmon S. dos Santos, who collected the type and only known specimen of the species. Dos Santos, who works at the CEPEC herbarium, is an excellent collector who has been instrumental in documenting the flora of southern Bahia. His keen eye and his intimate knowledge of Bahia forests have resulted in discovery of numerous previously unknown species. A number of these, like *Erythroxylum santosii,* are apparently quite rare and have not been found by other collectors. He has also been an able assistant and amiable field companion to many botanists visiting southern Bahia.

DISTRIBUTION—Known only from the type collection.

ECOLOGY—This species grows in the understory of the tropical moist forest in the Itanhém (formerly Alcobaça) River valley in southern Bahia.

PHENOLOGY—The only known collection was flowering in May.

RELATIONSHIPS—*Erythroxylum santosii* belongs to section *Archerythroxylum* and is clearly related to *E. ochranthum* Mart., a rarely collected species known only from coastal Bahia. *Erythroxylum santosii* can be separated from *E. ochranthum* using characters listed in Table 5.

8. **Erythroxylum splendidum** Plowman, sp. nov. sect. **Megalophyllum** O. E. Schulz. Figures 13–15, 18.

Frutex vel arbuscula gracilis, virgata. Ramuli recti, adscendentes. Cataphylla sparsa, remota, stipulis foli-

TABLE 5. Morphological comparison of *Erythroxylum santosii* Plowman and *E. ochranthum* Mart.

Character	*E. santosii*	*E. ochranthum*
Leaf shape	Oblong, lanceolate, or oblanceolate	Elliptic to oblong
Leaf surface	Dull, opaque	Somewhat shiny, translucent
Pedicel shape	Recurved	Straight
Pedicel length (mm)	1.5–2	2.5–8
Calyx lobe shape	Lanceolate	Ovate
Ovary vs. staminal cup	Equal	Twice as long

aribus similia. Stipulae foliares persistentes, triangulari-ovatae, estriatae, 2-setulosae. Folia in ramulis dispersa, disticha, petiolata, persistentia; laminae ovatae vel oblongae vel lanceolato-ovatae vel ellipticae, apice obtusae vel rotundatae, basi breviter acuminatae, coriaceae, ubique nitidae. Flores e ramulis hornotinis vel annotinis in axillis foliorum vel cataphyllorum nati. Petali lamina elliptica vel late ovata, ligula bilobata munita. Urceolus stamineus tribus quartis partibus longitudinis calycis aequalis vel calycem aequans, margine integer. In floribus brachystylis styli liberi. Drupa ellipsoidea, parum falcata, apice rotundata, endocarpio paulo compresso, manifeste curvato-falcato, triquetro, triloculari, loculis vacuis duobus magnis, loculo fertili parvo, endospermio abundante.

Slender, virgate **shrub** or **treelet,** 1–5 m tall. **Trunk** solitary, to 2 cm in diameter. **Bark** smooth, longitudinally finely striate, light brown, ca. 1 mm thick; wood light tan. **Branches** all near top on older individuals, ascending, straight, brown, "knobby" at the nodes. **Branchlets** distichous, straight, often parallel, diverging 50°–70° from axis, compressed when very young, soon becoming terete, 1.5–2 mm in diameter, dark reddish brown, furnished abundantly with pale tan, punctate or elongate lenticels, the branchlets becoming "stubby" at apex through abscission of terminal bud. **Internodes** 5–20 mm long. **Cataphylls** (ramenta) 3–6, sparse, distichous, scattered along base of new shoots, similar to foliar stipules, the spinule (leaf rudiment) 0.8 mm long, erect, straight, black. **Foliar stipules** persistent, erect, straight, triangular-ovate, 1.5–2.3 mm long, subcoriaceous, smooth, nonstriate, drying dark brown or black, obtuse at apex, 2-setulose, the setae filamentous, 0.3–0.6 mm long, evanescent, the keels prominulous, sub-alate, the margin straight, entire. **Leaves** persistent, scattered along younger branches, distichous, petiolate, the lamina plane or somewhat undulate, ovate to oblong, lance-ovate or elliptic, obtuse to rounded at apex, rarely retuse, short-acuminate at base, 40–105 mm long, 20–45 mm wide, subcoriaceous to coriaceous, adaxially shiny, dark green, abaxially less shiny, lighter green, drying ferruginous on both surfaces, elineate with no distinct central panel, the adaxial midrib flat, rarely with a fine medial ridge, the lateral nerves 8–12, diverging 50°–70° from midrib, straight, eventually arching and anastomosing 2–3 mm from margin, prominulous on both surfaces, the veinlets obscure. **Petiole** 5–15 mm long, 1–1.2 mm in diameter, subterete. **Flowers** fasciculate in axils of leaves or cataphylls on new and seasoned shoots, 1–6 flowers produced per node, 1–3 flowers at anthesis at each flowering node per day. **Bracteoles** persisting, giving nodes a "knobby" appearance, orbicular, concave, 1.2–1.8 mm long, paleaceous, rounded at apex, the seta 0.2–0.5 mm long. **Pedicel** short, thick, 5-angled or 5-ribbed, 1–2 mm long, 1 mm in diameter. **Calyx** 1.5–2.5 mm long, divided to near base, pale green, the lobes strongly incurved, narrowly ovate to lanceolate, 1.5–2.2 mm long, narrowly acuminate at apex. **Petal** lamina suberect or spreading at anthesis, creamy white or greenish white, concave, elliptic to broadly ovate, rounded at apex, the apex incurved, 1.5–3 mm long, 1.2–1.5 mm long, the claw 0.8–1.2 mm long, the ligule bilobed, 0.7–1.5 mm long, the posterior auricle well developed, facing sideways, ovate, 0.5–1.2 mm long, entire, the anterior auricle greatly reduced or absent. **Staminal cup** ¾ as long as or equaling the calyx, 1–1.5 mm long, entire at margin. **Brachystylous flowers:** filaments 2–3 mm long, the anthers suborbicular, 0.4–0.5 mm in diameter; styles 1–1.5 mm long, connate 0.3–0.5 mm; stigma depressed-capitate, 0.2–0.3 mm long. **Dolichostylous flowers:** antisepalous filaments 0.8–1 mm long, the anthers orbicular, 0.45–0.50 mm in diameter; antipetalous filaments 1.5–2 mm long, the anthers orbicular, 0.40–0.45 mm long; styles 2.2–2.3 mm long, connate at base 0.6–1 mm; stigma subglobose, 0.2–0.4 mm long. **Ovary** ellipsoid, shallowly 3-sulcate, rounded at apex, a little shorter to a little longer than staminal cup, 1.2–1.8 mm long. **Drupe** ellipsoid, somewhat falcate, rounded at apex, 10–13 mm long, 6 mm in diameter, shiny,

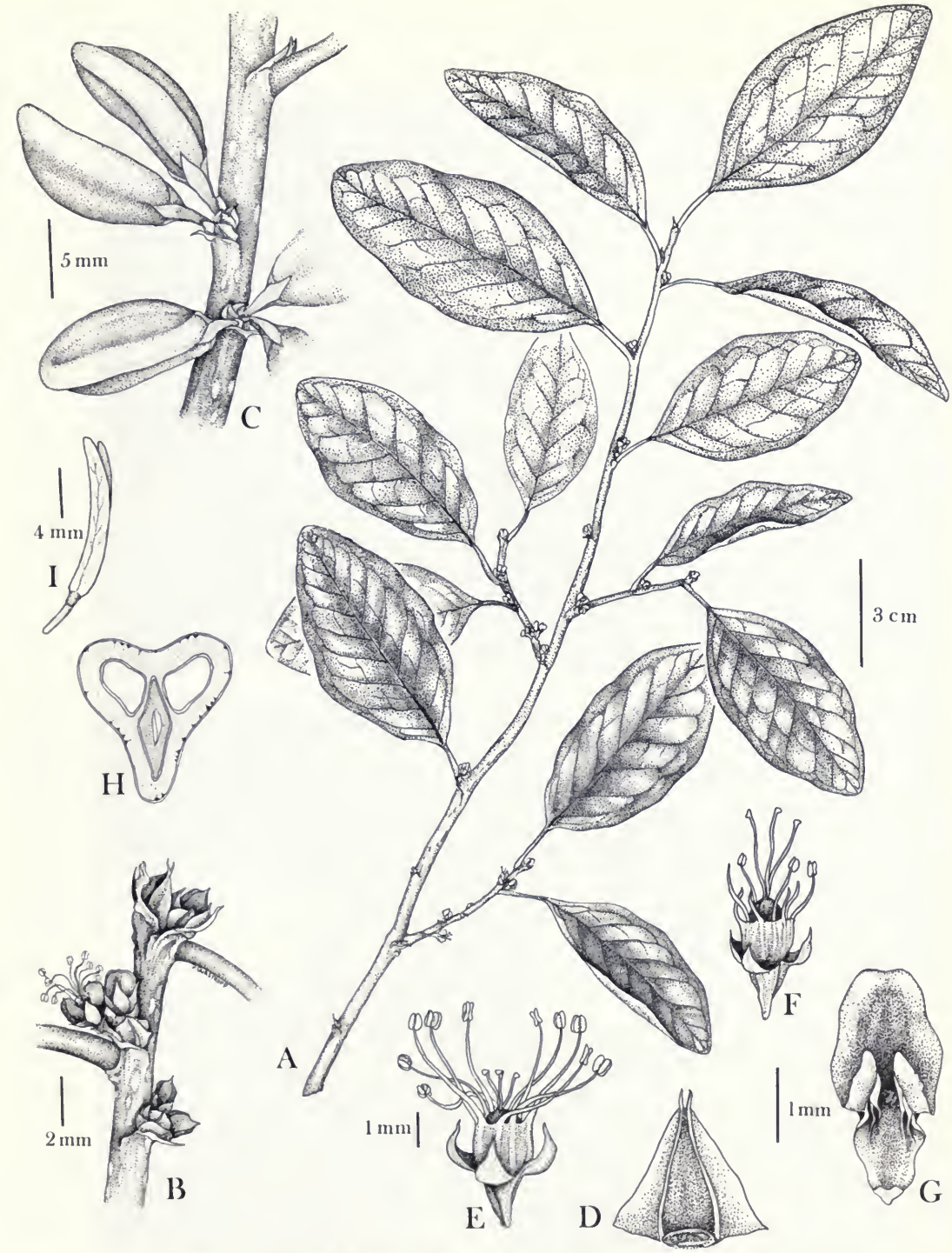

FIG. 13. *Erythroxylum splendidum*. **A,** flowering branch; **B,** detail of apex of flowering twig; **C,** detail of fruits on twig; **D,** stipule, scale as in G; **E,** short-styled flower; **F,** long-styled flower, scale as in E; **G,** petal; **H,** cross section of drupe, scale as in B; **I,** embryo. (A, B, D, E, and G from *Belém & Pinheiro 2466*; C, H, and I from *Mattos Silva et al. 1262*; F from *Belém & Pinheiro 3170*.) Drawing by Pollyanna Quasthoff.

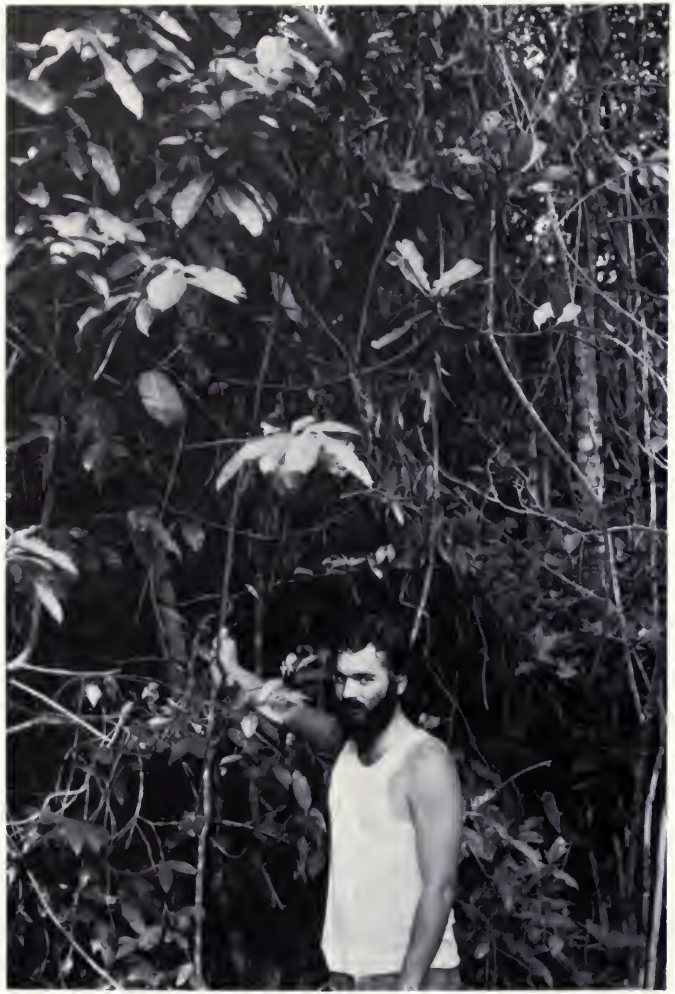

FIG. 14. Habit of *Erythroxylum splendidum* in restinga near Valença, Bahia, Brazil (*Plowman & Carvalho 12818*, type). The stem of *E. splendidum* is being held by André M. de Carvalho of CEPEC.

FIG. 15. Detail of flowers and fruits of *Erythroxylum splendidum* (*Plowman & Carvalho 12818*, type).

reddish orange at maturity, the mesocarp 0.5–0.7 mm thick, the endocarp 9–12 mm long, compressed, strongly curved-falcate, unequally trigonal with 2 shorter obtuse lobes and 1 longer, narrowly acute lobe, acute at apex, 3-locular with 2 larger, empty locules and 1 small, fertile locule; endosperm occupying ca. 80% of fertile locule. **Embryo** 7.2–9.5 mm long; cotyledons linear-lanceolate, somewhat falcate, 5.5–7 mm long, 1 mm wide, 0.1–0.2 mm thick; radicle 2–2.5 mm long, 0.5 mm in diameter.

TYPE—Brazil, Bahia, Município de Valença, km 9 na estrada Valença–Guaibim, approx. 13°18′S, 39°00′W, arboreal restinga on white sand near sea level; slender treelet 5 m tall growing in disturbed restinga, flowers creamy white, 6 Feb. 1983 (fl, fr), *T. Plowman & A. M. de Carvalho 12818* (holotype, CEPEC 32439; isotypes, F, F neg. 60186, G, HRB, K, NY, RB, SP, UB, US).

ADDITIONAL SPECIMENS EXAMINED—**BRAZIL: Bahia:** Município de Valença: ramal à esquerda da rodovia que liga Valença ao Guaibim (litoral), com entrada no km 9, 11 Dec. 1980 (fr), *L. A. Mattos Silva, A. M. de Carvalho & J. L. Hage 1262* (CEPEC, F, HRB, HUEFS, MBM, RB), 6 Feb. 1983 (st), *T. Plowman & A. M. de Carvalho 12819* (CEPEC, F, K, RB), same locality, km 8, 27 Jul. 1981 (fl, fr), *A. M. de Carvalho & J. Gatti 815* (CEPEC, F, HRB, K, NY, RB), same locality, km 10, 8 Jan. 1982 (fl, fr), *A. M. de Carvalho & G. P. Lewis 1125* (ALCB, CEPEC, F, SPF), same locality, km 15, 25 Feb. 1986 (fr), *J. L. Hage, L. Andersson & M. Hagberg 1953* (CEPEC, F), *1955* (CEPEC, F). Município de Cairu: rodovia Nilo Peçanha–Cairu, km 14–18, 29 Apr. 1980 (fr), *T. S. dos Santos, L. A. Mattos Silva & E. B. dos Santos 3594* (CEPEC, F). Município de Maraú: Maraú, 18 Jan. 1967 (fl, fr), *R. P. Belém & R. S. Pinheiro 3170* (CEPEC, F, NY, UB). Município de Itacaré: 65 km NE of Itabuna at mouth of the Rio de Contas on the N bank opposite Itacaré, 39°00′W, 14°16′S, sea level, 30 Jan. 1977 (fl), *R. M. Harley et al. 18417* (CEPEC, F, K.). Município de Belmonte: Belmonte, 30 Jun. 1966 (fl), *R. P. Belém & R. S. Pinheiro 2466* (CEPEC, F, IAN, NY, UB); ca. 26 km SW of Belmonte along road to Itapebi and 4 km along side road toward the sea, ca. 39°02′W, 16°03′S, alt. sea level, 25 Mar. 1974 (fr), *R. M. Harley 17402* (CEPEC, K, NY, RB). Without exact locality: ca. 1832, *J. S. Blanchet* (BM, G, F neg. 26398, photos F, GH, NY, distributed as "*E. grandifolium*").

ETYMOLOGY—From Latin *splendidus,* meaning "shining" or "splendid," in reference to the handsome, glossy leaves of this species.

DISTRIBUTION—*Erythroxylum splendidum* occurs only along the coast of Bahia, Brazil, from Valença south to Belmonte, covering a distance of only 150 km.

ECOLOGY—This species grows only in arboreal or shrubby restinga vegetation near the sea on sandy soil. It appears to be nowhere very abundant, but some large areas of the restingas of Bahia remain to be explored botanically.

PHENOLOGY—*Erythroxylum splendidum* has been collected in flower or fruit every month from December to July, but no collections have been made between August and November. This may reflect a true flowering period or merely a collecting accident.

RELATIONSHIPS—The first collection of *E. splendidum* was made by Blanchet in Bahia about 1832; the plant was not collected again until 1966. Schulz (1907) identified the Blanchet specimen, which has abnormally pointed leaves, as *E. grandifolium* Peyr., and this is indeed the closest relative of *E. splendidum. Erythroxylum splendidum* differs from *E. grandifolium* primarily in having dark reddish brown (vs. light tan or whitish) bark on the twigs, much smaller (40–105 mm vs. 110–250 mm long), ovate to oblong (vs. elliptic) leaves with obtuse or rounded (vs. acuminate) apices.

Schulz (1907) placed *E. grandifolium* in section *Megalophyllum* O. E. Schulz. This group includes four species from southeastern Brazil with large leaves, nonstriate stipules, and numerous, glomerate, sessile flowers with more or less connate styles. Three of the species are endemics from Rio de Janeiro. Schulz thought that *E. grandifolium* grew in Rio and Bahia, and noted that the Bahian specimen of Blanchet had much smaller leaves. The type of *E. grandifolium* is *Riedel 774* collected at "Esperança," a locality reported to be in the state of Rio de Janeiro (Peyritsch, 1878). However, this species has never been recollected in the state of Rio, but is known from several collections from southern Bahia, where most probably it is endemic in the coastal forests. "Esperança" is most likely an old name for a fazenda or farm in the area around Ilhéus where Riedel spent considerable time.

One of the most distinctive features of *E. grandifolium* and *E. splendidum* is the endocarp which has one small, fertile locule and two larger, empty locules. This character is found in another species with nonstriate stipules from Bahia, *E. caatingae* (and probably in the related *E. oxypetalum* O. E. Schulz) of section *Archerythroxylum.* However, trilocular endocarps are found also in some species with striate-nerved stipules of section *Rhabdophyllum* (cf. *E. laetevirens* O. E. Schulz and *E. steyermarkii* Plowman) as well as in some Old World species (Schulz, 1907).

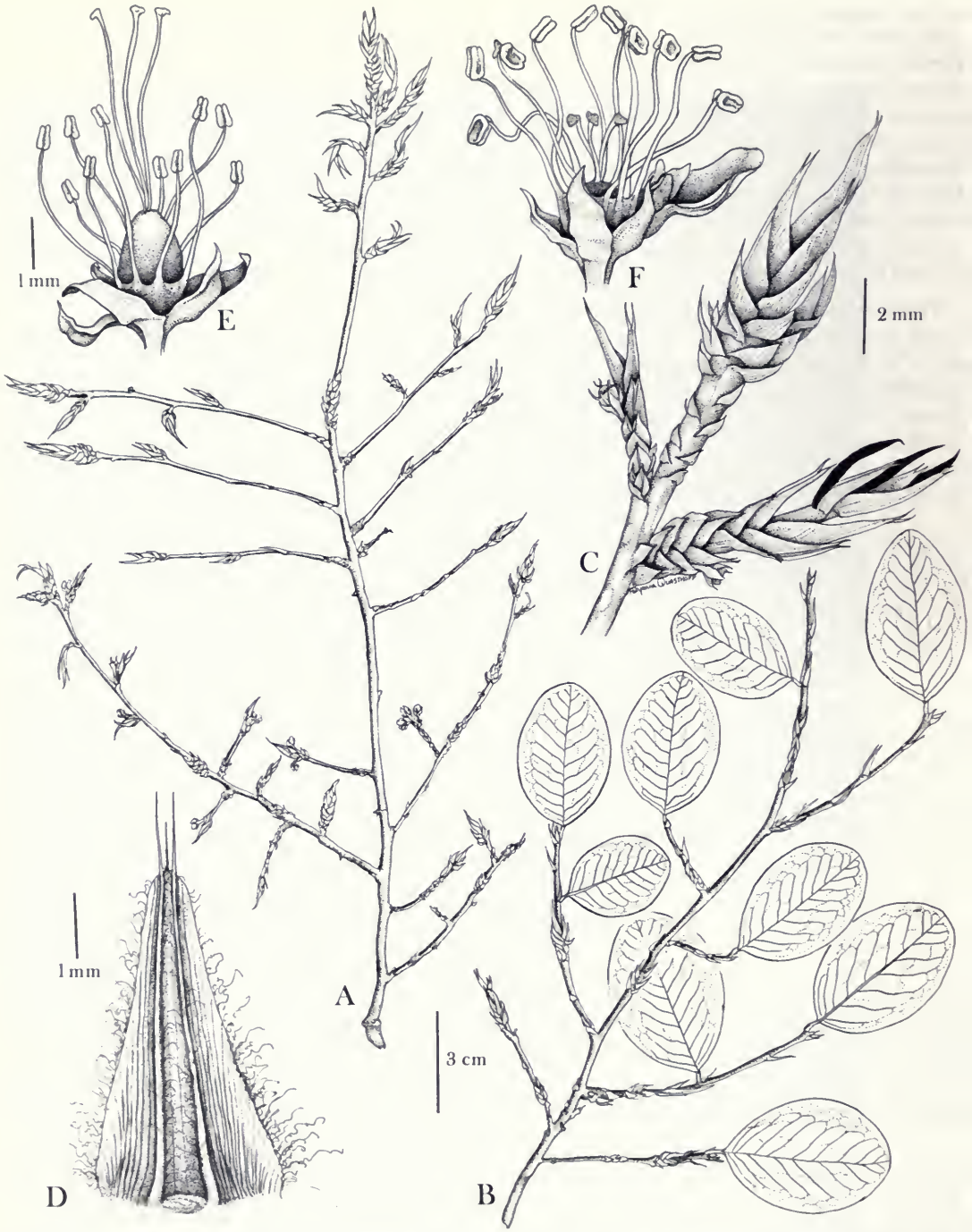

FIG. 16. *Erythroxylum stipulosum*. **A,** leafless flowering branch, 3-cm scale; **B,** sterile branch with mature leaves, 3-cm scale; **C,** detail of flowering twig; **D,** stipule; **E,** long-styled flower; **F,** short-styled flower, scale as in E. (A, C, and D from *Luetzelberg 26459*; B from *Black 55-17977*; E from *Luetzelberg 26187*; F from *Luetzelberg 26464*.) Drawing by Pollyanna Quasthoff.

FIG. 17. Habitat of *Erythroxylum stipulosum* at Chapada de Araripe, Ceará (*Plowman & Caçula 12716*). *Erythroxylum stipulosum* is marked with arrow. *Erythroxylum vacciniifolium* is tall, leafy shrub forming background (*Plowman & Caçula 12717*). The man is José "Arnaldo" Tavares Caçula, resident guard of the Parque Nacional de Araripe.

9. **Erythroxylum stipulosum** Plowman, sp. nov. sect. **Rhabdophyllum** O. E. Schulz. Figures 16–18.

Frutex dense ramosus, ramulis nigrescentibus, longitudinaliter striate fissuratis. Cataphylla conspicua, congesta, disticha, paleacea, stipulis foliaribus similia. Stipulae foliares oblongo-lanceolatae, striate nervosae, longe 3-setulosae, margine manifeste villoso-fimbriatae, marcescentia. Folia brevissime petiolata, decidua; laminae ellipticae, apice et basi rotundatae, firme chartaceae, opacae. Flores solitarii e ramulis annotinis in axillis cataphyllorum nati. Urceolus stamineus calyce dimidio brevior, margine integer. Styli liberi. Drupa ignota.

Much-branched, erect **shrub** to 3 m tall with single trunk to 2 cm diameter. **Bark** smooth, dark brown, longitudinally striate, ca. 1 mm thick, reddish brown within, the wood light tan. **Branches** short, ascending and spreading, light brown. **Branchlets** dense, rather straight, diverging 55°–90° from axis, compressed at apex when new, more or less longitudinally wrinkled, becoming terete, 1–1.2 mm in diameter, black or dark brown, smooth, sometimes with a few, elongate, light tan lenticels, becoming longitudinally striately fissured. **Internodes** 3–20 mm long. **Cataphylls** (ramenta) large, conspicuous, congested, at apex of twigs forming a terminal bud, covering stem through 5–15 mm, 4–6 mm wide, diverging from stem up to 30°, distichous, chaffy, light brown, persisting but marcescent, similar in form to foliar stipules, the spinule (leaf rudiment) appressed to cataphyll, flattened, 1 mm long, acute at apex, black. **Foliar stipules** appressed to stem, oblong-lanceolate, 3.5–6 mm long, chaffy, straw-colored, markedly striate-nerved with 5–8 closely parallel nerves per side, acute to attenuate at apex, 3-setulose, the 2 lateral setae 0.7–1.5 mm long, the medial seta 0.3–1 mm long, the apex of the stipule becoming ragged with age, the keels prominent with a slender medial ridge, fimbriate, the margin densely villose-fimbriate when new. **Leaves** 1–3 scattered on new twigs, deciduous, distichous, short-petiolate, the lamina plane, broadly to narrowly elliptic, rounded and mucronulate at apex,

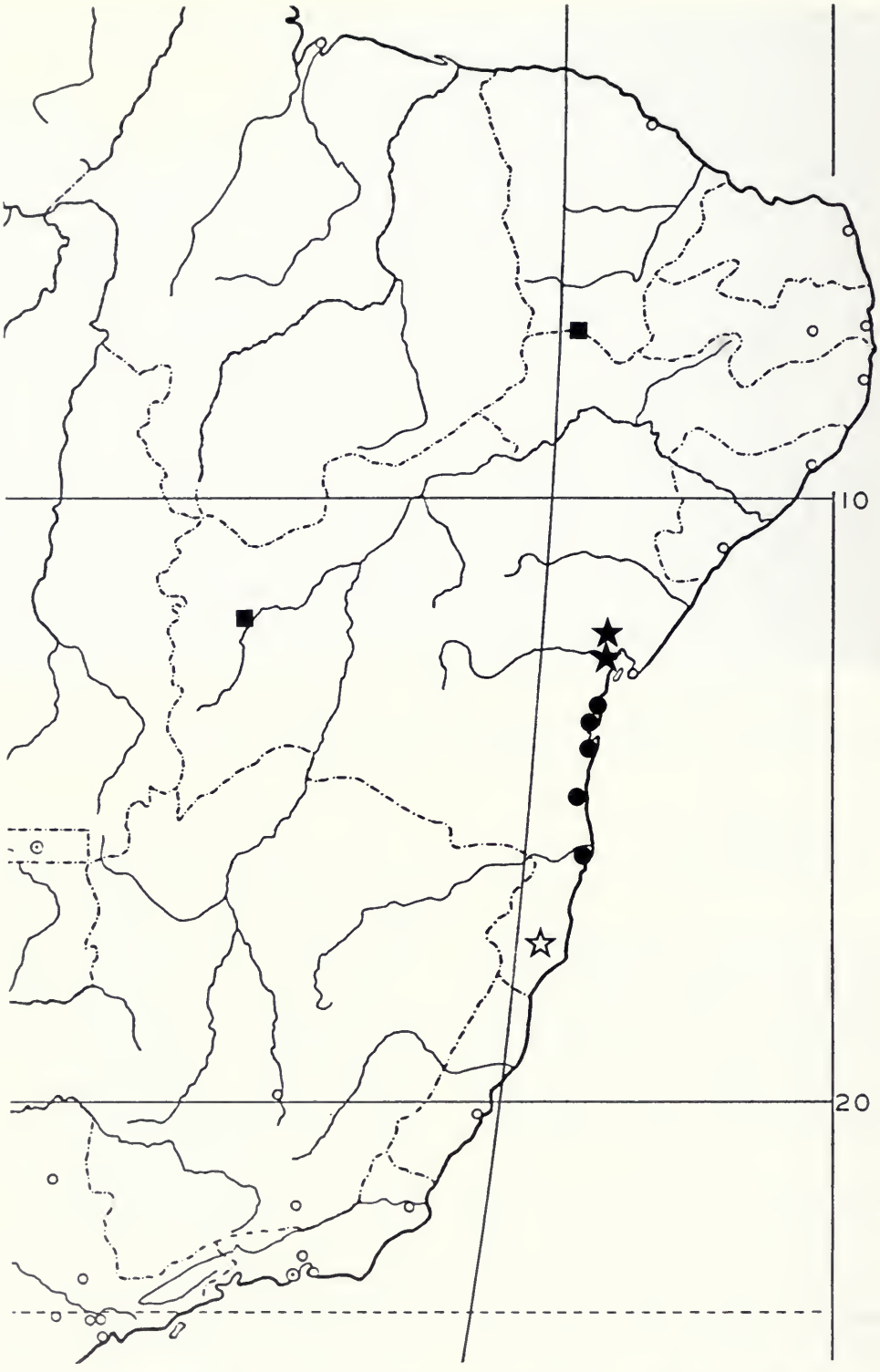

FIG. 18. Known geographical distribution of new *Erythroxylum* species in eastern Brazil. Solid stars = *E. petrae-caballi*; open star = *E. santosii*; solid circles = *E. splendidum*; solid squares = *E. stipulosum*.

rounded at base, 38–55 mm long, 22–26 mm wide, firmly chartaceous, opaque, drying adaxially dark brown, abaxially pale brown, somewhat shiny adaxially, dull abaxially, elineate with the central panel barely distinct, the adaxial midrib a low, slender, medial ridge, the lateral nerves 10–12, diverging 50°–70° from midrib, straight, then arching irregularly, anastomosing 2–3 mm from margin, prominulous on both surfaces, obscured somewhat by prominent, reticulate veinlets. **Petiole** 2 mm long, 1 mm in diameter, subterete. **Flowers** produced singly in axils of last season's ramenta, sparse to somewhat congested. **Bracteoles** lanceolate in outline, cymbiform, 2.5–3 mm long, chaffy, acute to attenuate at apex, the seta 0.3–1 mm long. **Pedicel** pentangular, 5-ribbed, 1.5–3.5 mm long, 0.5 mm in diameter. **Calyx** 1.5–2 mm long, divided nearly to base, the lobes lanceolate, acute to acuminate at apex, incurved, 0.8–1.8 mm long. **Petal:** specimen lost. **Staminal cup** ½ length of calyx, 0.6–0.8 mm long, entire at margin. **Brachystylous flowers:** filaments 2.2–2.5 mm long, the anthers oblong-ovate, 0.5 mm long; styles free, 1.1 mm long; stigma depressed-capitate, 0.3 mm long. **Dolichostylous flowers:** antisepalous filaments 1.3–2 mm long, the anthers oblong-ovate, 0.4–0.5 mm long; antipetalous filaments 2–2.5 mm long, the anthers oblong-ovate, 0.4–0.5 mm long; styles free, 2.8 mm long; stigmas depressed-capitate, 0.3–0.5 mm long. **Ovary** ovoid, becoming trigonal in young fruit, rounded at apex, 1.2 times length of staminal cup, 1 mm long. **Drupe** not seen.

TYPE—Brazil, Ceará, Serra do Araripe, Bom Fim, carasco [*sic*], 17 Jan. 1935 (fl), *P. von Luetzelberg 26187* (holotype, M, F neg. 60126).

ADDITIONAL SPECIMENS EXAMINED—**BRAZIL: Ceará:** Serra do Araripe: Araras, 11 Feb. 1935 (fl), *P. von Luetzelberg 26464* (NY, F NEG. 16464); Baixa Rasa, 11 Feb. 1935 (fl), *P. von Luetzelberg 26459* (M, F neg. 60127). Município de Crato: Parque Nacional do Araripe, access road E of federal road BR-122, ca. 20 km SW of Crato, ca. 7°20'S, 39°35'W, alt. 860 m, 18 Jan. 1983 (st), *T. Plowman & J. Tavares Caçula 12716* (ALCB, CEPEC, EAC, F, G, HRB, IPA, K, M, MBM, MO, NY, P, R, RB, SP, U, UB, US). **Bahia:** região de Barreiras, Chapadão da Panair, Serra do Mimo, Grameal da Onça, 1 Jan. 1955 (st), *G. A. Black 55-17977* (IAN, F neg. 60129).

ETYMOLOGY—The specific epithet is derived from Latin *stipulosus,* "having very large stipules," in reference to the large, conspicuous stipules.

DISTRIBUTION—*Erythroxylum stipulosum* is known only from the Serra do Araripe on the border of Ceará and Pernambuco states, and from one collection near Barreiras in western Bahia.

ECOLOGY—This species inhabits an open vegetation type best described as "closed shrubby caatinga" (Eiten, 1983). There is little agreement on the classification of dry vegetation types in northeastern Brazil, and different authors vary widely in their opinions. In the Serra do Araripe, *E. stipulosum* was said to be growing in *carrasco,* a term which locally is used for closed caatinga scrub vegetation on sandy soil. It is noteworthy that the species was not found growing in adjacent habitats of *cerradão* or "cerrado woodland."

Three other species of *Erythroxylum* were found growing alongside *E. stipulosum* in the *carrasco* vegetation on the Chapada do Araripe: *E. vacciniifolium* Mart., *E. rosuliferum* O. E. Schulz (if distinct from *E. betulaceum* Mart.), and *E. loefgrenii* Diogo. Of these only *E. vacciniifolium* is widespread, occurring from Ceará south to Santa Catarina in a diversity of habitats. The other two species are restricted to dry formations in northeastern Brazil. None of these four species occurred in adjacent cerrado woodland where *E. barbatum* O. E. Schulz and *E. suberosum* were found. Neither of the latter was found in *carrasco.* Clearly the distribution of species in these related yet apparently different habitats needs to be studied more closely.

PHENOLOGY—*Erythroxylum stipulosum* flowers apparently from mid-January to mid-February with the advent of the winter rains. Since rains are notoriously unpredictable in northeastern Brazil, the flowering time may vary appreciably from year to year. Fruits are unknown in this species.

RELATIONSHIPS—*Erythroxylum stipulosum* is a very distinct species, easily distinguished by its long, fimbriate stipules. It belongs to section *Rhabdophyllum,* but within that large group has no apparent close relatives. It may be related to *E. pelleterianum* St. Hil. and *E. subracemosum* Turcz., both of which have somewhat fimbriate but much shorter stipules. *Erythroxylum stipulosum* might also be confused with the poorly known *E. strobilaceum* Peyr. (syn. *E. warmingii* Peyr.) from Minas Gerais, but in that species the stipules are entire (vs. fimbriate), the enlarged cataphylls of the ramenta are caducous (vs. persistent and marcescent), and the pedicel is much longer (9–11 mm vs. 1.5–3.5 mm).

Additional collections of *E. stipulosum* are necessary to furnish better material of mature leaves (especially from Chapada do Araripe), flowers, and

FIG. 19. *Erythroxylum tenue*. **A,** flowering branch; **B,** habit of entire plant; **C,** detail of twig apex; **D,** stipule, scale as in F; **E,** leaf showing venation; **F,** short-styled flower; **G,** long-styled flower, scale as in F; **H,** petal, scale as in F; **I,** immature fruit. (A, B, C, D, E, F, and H from *Plowman & Carvalho 12812*; G from *Pinheiro 2046*; I from *dos Santos 1712*.) Drawing by Marlene Werner.

FIG. 20. Restinga forest habitat of *Erythroxylum tenue* at type locality near Ituberá, Bahia (*Plowman & Carvalho 12812*). The palm at left is piaçaba (*Attalea funifera*), which is characteristic of this habitat in southern Bahia. *Erythroxylum mucronatum* Benth., *E. martii* Peyr., *E. nobile* O. E. Schulz, and *E. cuspidifolium* Mart. were also found growing with *E. tenue* in this same restinga forest.

most importantly fruits, in order to determine its relationships with other species.

10. **Erythroxylum tenue** Plowman, sp. nov. sect. **Rhabdophyllum** O. E. Schulz. Figures 19–23.

Frutex gracillimus. Rami et ramuli recti, tenues. Cataphylla pauca, remota, stipulis foliaribus similia. Stipulae foliares persistentes, manifeste striate nervosae, 2-setulosae. Folia in ramulis dispersa, breviter petiolata, persistentia; laminae anguste ovatae vel lanceolatae, apice late vel anguste acutae, basi obtusae vel acutae, membranaceae, supra aliquantum nitidae, subtus impolitae. Flores e ramulis hornotinis vel annotinis in axibus brevissimis in axillis foliorum vel ramentorum nati. Petali lamina lingulata, armeniaca vel ochracea, ovata vel oblonga, ligula bilobata munita, utroque lobo usque ad medium valde incrassato et auricula brevi proviso. Urceolus stamineus calyce longior (× 1.2–1.5), margine eroso-crenulatus, quinque dentibus antisepalis prominulis munitus. Styli usque ad medium connati. Drupa ellipsoidea, apice rotundata et subexcentrica, endocarpio obovoideo, apice subexcentrico, tereti, longitudinaliter nervoso, maturitate uniloculari.

Shrub to 3 m tall with 1 slender trunk ca. 2 cm in diameter. **Bark** thin, smooth, more or less shiny, dark brown with scattered brown lenticels, ca. 1.5 mm thick; wood light tan. **Branches** plagiotropic, horizontal, somewhat storied, straight, without short shoots. **Branchlets** distichous, slender, straight, diverging 30°–90° from stem, a little compressed at apex, soon becoming terete, 1 mm in diameter, smooth, dark brown, somewhat shiny, without lenticels. **Internodes** 1–15 mm long. **Cataphylls** (ramenta) few, scattered along base of new shoots, the spinule (rudimentary leaf) straight, brown, 0.3–0.7 mm long, caducous. **Foliar stipules** persistent, appressed to stem, diverging somewhat with age, broadly ovate to broadly triangular, 1–2 mm long, markedly striate-nerved with 4–6 nerves per side, pale green, becoming chaffy with age, obtuse to rounded at apex, 2-setulose, the setae minute, filamentous, 0.2–0.3 mm long, evanescent, the keels prominent, slightly alate, the margin entire. **Leaves** persistent, scattered along branchlets or sometimes clustered toward apex, distichous, petiolate, the lamina plane, narrowly ovate to lanceolate, broadly to narrowly acute at apex, rarely obtuse or acuminate, obtuse to acute at base, 24–67 mm long, 9–28 mm wide, membranaceous, adaxially medium to dark green, shiny,

FIG. 21. Slender habit of the type plant of *Erythroxylum tenue* (*Plowman & Carvalho 12812*).

drying dark, grayish green, abaxially dull, very pale green, drying ochreous or ferruginous, elineate and with no distinct central panel, the adaxial midrib flat with a very slender, low, medial ridge, the lateral nerves 9–12 per side, diverging 50°–70° from midrib, sinuous, obscure on both surfaces when fresh, appearing slender and faint when dried, the veinlets fine, open-reticulate. **Petiole** 2.5–4 mm long, subterete, broadly canaliculate. **Inflorescences** produced in the axils of leaves or cataphylls on current or last season's shoots on a short axis to 2.5 mm long, the axis itself very short-pedunculate, the peduncle flattened, appressed to stem, 0.5–0.7 mm long. **Flowers** ca. 3 per node, ap-

FIG. 22. Flowering branch of the type plant of *Erythroxylum tenue* (*Plowman & Carvalho 12812*).

pearing sequentially, one at a time. **Bracteoles** persistent, minute, spirally imbricate on short axis, broadly ovate, concave, 0.6–1 mm long, membranaceous, sparingly nerved, obtuse or rounded at apex, the seta 0.1–0.4 mm long. **Pedicel** terete, 5-ribbed, 1.2–4 mm long. 0.5–0.7 mm in diameter, slightly thickened toward apex. **Calyx** 1–1.5 mm long, divided ⅓–½ its length, pale green, becoming ochreous, the lobes triangular to ovate, acute to obtuse, 0.5–0.7 mm long. **Petal** lamina lingulate, rather thick, convex with slightly depressed midrib, recurving at anthesis, pale orange to ochreous, ovate to oblong, rounded or truncate at apex, 1.2–2 mm long, 0.8–1.2 mm wide, the claw 0.7–1.5 mm long with a pair of gibbous bulges at base, the ligule bilobate, thickened, 0.6–0.7 mm long, creamy white, each lobe with a single, reduced auricle 0.5–0.6 mm long, separated by a swollen, lingulate, inflexed flap. **Staminal cup** 1.2–1.5 times length of calyx, 1–1.3 mm long, erose-crenulate at margin with 5 short, protruding, antisepalous "teeth." **Brachystylous flowers:** filaments somewhat variable in length, 1–1.7 mm long; anthers 0.4–0.5 mm long; styles 1–1.3 mm long, connate for half their length; stigmas depressed-capitate, 0.2 mm long. **Dolichostylous flowers:** antisepalous filaments 0.8 mm long, the anthers 0.5 mm long; antipetalous filaments 1.2 mm long, the anthers 0.4 mm long; styles 3 mm long, connate for 1 mm; stigma depressed-capitate, 0.3 mm long. **Ovary** obovoid-obconic, broadly rounded at apex, ½–⅓ the length of staminal cup, 0.6–0.9 mm long. **Drupe** ellipsoid, slightly excentric at apex, rounded, 10 mm long, 6 mm in diameter, red at maturity, the mesocarp 0.7 mm thick, the endocarp narrowly obovoid, slightly excentric at apex, narrowed at both ends, terete, with ca. 12 longitudinal nerves, unilocular with 2 collapsed rudimentary locules at base; endosperm occupying ca. 50% of locule. **Embryo** 7 mm long; cotyledons oblong, the apex rounded, slightly excentric, basally subcordate, 6.5 mm long, 3 mm wide, 0.3 mm thick; radicle 1.3 mm long.

TYPE—Brazil, Bahia, Município de Ituberá, km 11 na estrada Ituberá–Valença, 1–2 km no ramal de acesso à Estação da Telebahia, ca. 13°40′S, 39°07′W, near sea level, slender, erect single-stemmed shrub 3 m tall, calyx yellowish brown, petals dirty yellowish, ligule white, 4 Feb. 1983

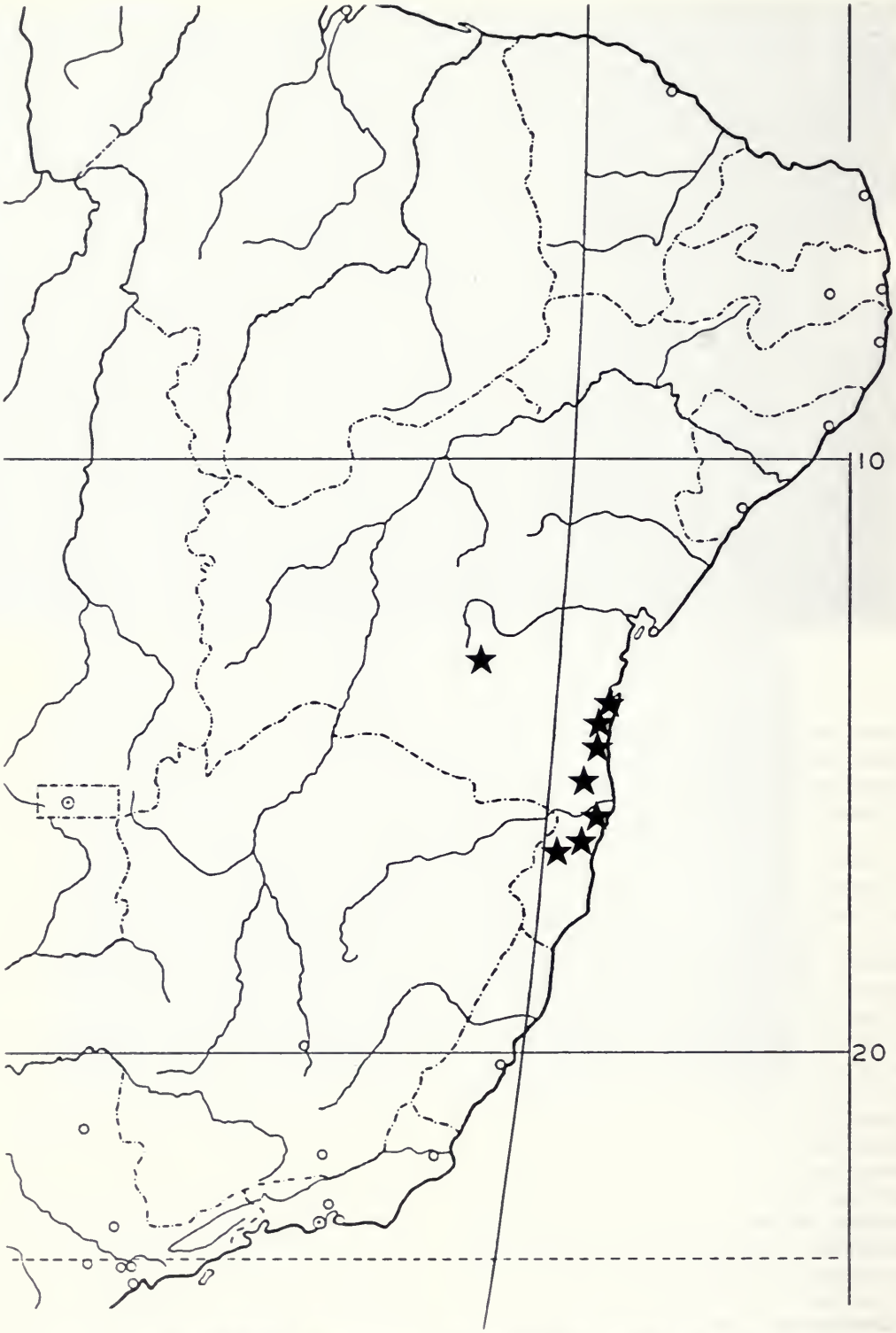

FIG. 23. Known geographic distribution of *Erythroxylum tenue* in Bahia in eastern Brazil.

(fl), *T. Plowman & A. M. de Carvalho 12812* (holotype, CEPEC 32462; isotypes, ALCB, F 1916664, F neg. 60187, G, GH, HRB, IPA, K, LE, MBM, MO, NY, P, R, RB, SP, U, UB, US).

ADDITIONAL SPECIMENS EXAMINED—**BRAZIL: Bahia:** Município de Camamú: Acaraí, estrada ao lado sul, 1 Jul. 1971 (fl, imm fr), *T. S. dos Santos 1712* (CEPEC, F). Município de Maraú: rodovia BR 030, trecho Ubaitaba–Maraú, 45–50 km a leste de Ubaitaba, ca. 50 m alt., 14°11'S, 30°01'W, 12–13 Jun. 1979 (fr), *S. Mori et al. 11965* (CEPEC, F, K, NY, RB). Município de Itacaré: Itacaré, 6 Jan. 1967 (fl, imm fr), *R. P. Belém & R. S. Pinheiro 3009* (CEPEC, F, K, NY, RB). Município de Itabuna: Fazenda Pirataquicé, 30 Nov. 1970 (fl), *L. Emygdio de Mello Filho 3022 & M. Emmerich 3560* (CEPEC). Município de Ilhéus: prope Ilhéus, Feb. 1822 (fl), *L. Riedel 612* (F, fragment, K, LE, F neg. 59917, P, excluded syntype of *E. bongardianum* C. A. Meyer ex Peyr.); km 35 na estrada Ilhéus–Serra Grande, 22 Oct. 1983 (fl), *A. M. de Carvalho et al. 2007* (CEPEC, F); Fazenda Barra do Manguinho, ramal com entrada no km 10 da rodovia Pontal–Olivença, lado direito, 3 km a oeste da rodovia, 5 Feb. 1982 (fl), *L. A. Mattos Silva, T. S. dos Santos & B. Boom 1443* (CEPEC, F); entre km 5–8 da estrada Olivença–Maruim, alt. 30–50 m, 14 Oct. 1983 (fl), *M. P. M. de Lima et al. 22* (CEPEC, RB), same locality, km 7, 16 Apr. 1986 (fl), *L. A. Mattos Silva, T. S. dos Santos & J. L. Hage 2043* (CEPEC, F); estrada que liga Olivença à Vila Brasil, km 7, 16 Feb. 1982 (fr), *L. A. Mattos Silva, A. M. de Carvalho & T. S. dos Santos 1528* (ALCB, CEPEC, F, HBR, RB); estrada que liga a Estação Hidromineral de Olivença ao Povoado de Vila Brasil, 5 km ao sudoeste de Olivença, 8 Feb. 1982 (fl, imm fr), *L. A. Mattos Silva, T. S. dos Santos & G. P. Lewis 1487* (CEPEC, F, HRB), 26 Apr. 1983 (fl), *L. A. Mattos Silva, T. S. dos Santos & B. E. Leuenberger 1688* (B, CEPEC, F, HUEFS, RB); ramal novo para o povoado da Vila Brasil, com entrada no km 28 da rodovia Ilhéus–Una, lado direito, inicio do ramal km 3, 27 Feb. 1985 (fl), *T. Plowman, L. A. Mattos Silva & T. S. dos Santos 13963* (CEPEC, F, K, MO, RB), same locality, km 7, 27 Feb. 1985 (fl, imm fr), *T. Plowman, L. A. Mattos Silva & T. S. dos Santos 13964* (CEPEC, F, GH, NY, RB, SP). Município de Una: estrada Ilhéus–Una, 19 Nov. 1983 (fl), *R. Callejas, A. M. de Carvalho & L. A. Mattos Silva 1757* (CEPEC, F, MBM, NY). Município de Itapebi: Rodovia Itapebi a Camacã, 17 Oct. 1969 (fl), *J. A. de Jesus 465A* (RB). Município de Pôrto Seguro: km 7 da estrada Pôrto Seguro à Santa Cruz Cabrália, Taperapuã, 20 Apr. 1982 (fl, fr), *A. M. de Carvalho, S. G. da Vinha & E. S. Brito 1228* (CEPEC, F, RB, SPF); estrada Pôrto Seguro–Eunápolis, km 13, 18 Oct. 1969 (fl), *J. A. de Jesus 465B* (CEPEC, RB); Parque Nacional do Monte Pascoal, 18 Jan. 1974 (fl, imm fr), *T. S. dos Santos 2725* (CEPEC, F, K); rodovia para povoado de Trancoso, km 5 depois de Arraial d'Ajuda, 5 Nov. 1983 (fl), *R. Callejas, A. M. de Carvalho & L. A. Mattos Silva 1688* (CEPEC, F, MBM, NY). Município de Guaratinga: km 10, Guaratinga a São Paulinho, 29 Mar. 1973 (fl), *R. S. Pinheiro 2046* (CEPEC, F). Município de Ibicoara: região da Serra do Sincorá, 24 Feb. 1943 (fl), *R. L. Fróes 20092* (IAN, NY).

ETYMOLOGY—The specific epithet is derived from Latin *tenuis,* "thin" or "fine," referring to the slender trunk and branches of this species.

DISTRIBUTION—*Erythroxylum tenue* grows only in moist coastal forests in southern Bahia, Brazil, from Valença south to Parque Nacional do Monte Pascoal. The Fróes collection from Serra do Sincorá appears to be somewhat out of range. However, forest habitats do occur in this area (R. Harley, *in litt.*), and other species from the Atlantic forest, such as *Ruellia affinis* (Mart.) Lindau and *Brunfelsia clandestina* Plowman (Plowman, 1981), are known to occur here.

ECOLOGY—This species grows primarily in the understory of restinga forest on sandy soils near the coast, but has also been collected in areas of *mata higrófila* or tropical moist forest further inland, presumably on clay soils. It may be occasional to relatively abundant at any one locality.

PHENOLOGY—*Erythroxylum tenue* flowers and fruits throughout the year. The flowers are produced sequentially such that only a few flowers on an individual are open at a given time, but the flowers appear over a relatively long period.

RELATIONSHIPS—*Erythroxylum tenue* was first collected by Riedel at Ilhéus in 1822. Riedel's collection (no. 612) was cited as one of two syntypes of *E. bongardianum* C. A. Meyer ex Peyr. The second element (*Langsdorff s.n.*), from Espírito Santo, was the basis for the manuscript name "*E. bongardianum* C. A. Meyer" appearing on one sheet at LE. C. A. Meyer had worked with F. E. L. Fischer at LE on a general monograph of *Erythroxylum,* continuing earlier studies of the Brazilian species by A. G. H. Bongard. Although neither of these studies was ever published, O. E. Schulz, in preparing his worldwide monograph for *Das Pflanzenreich,* obtained the handwritten manuscripts and some of the lithographed plates (Schulz, 1907). Schulz cited in synonymy many *nomina nuda* from Bongard's and Fischer and Meyer's manuscripts. The original manuscripts have not been located at LE, and possibly were retained by Schulz at B and subsequently destroyed during World War II.

I here designate one duplicate of the Langsdorff collection at LE as the lectotype of *E. bongardianum* C. A. Meyer ex Peyr., for which I give the following reasons. The description published by Peyritsch applies principally to this collection. Peyritsch annotated many *Erythroxylum* specimens at Leningrad and may have had access to Meyer's notes. Meyer annotated only the Langsdorff collection as "*E. bongardianum,*" a duplicate of which Bongard had previously annotated as "*E. ovatum*"; Meyer annotated the Riedel collection at LE as "*E. minutiflorum.*" Last, Peyritsch himself

stated in a note appended to his description that the Riedel collection strongly suggested a separate species. From this analysis, it is clear that the Langsdorff collection must be chosen as the lectotype of *E. bongardianum*. The Langsdorff collection, however, in fact belongs to *E. passerinum* Mart., so that *E. bongardianum* must be placed in synonymy under that species. In spite of this confusion, the new name *E. tenue* is correctly applied to *Riedel 612*.

Erythroxylum tenue belongs to section *Rhabdophyllum*. Within this large and diverse complex, *E. tenue* belongs to the species group discussed above under *E. petrae-caballi*. Of the several similar species in this group that occur in Bahia, *Erythroxylum tenue* is the most distinct. The combination of a slender habit, the lack of short shoots, the small, narrowly ovate to lanceolate leaves, the brief elongation of the flowering axis, the thickened, reduced petal ligule, and the connate styles all serve to distinguish *E. tenue* from any other species. Table 4 gives the characters by which *E. tenue* differs from its closest congeners in Bahia.

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